

April 18, 1960

# Aviation Week

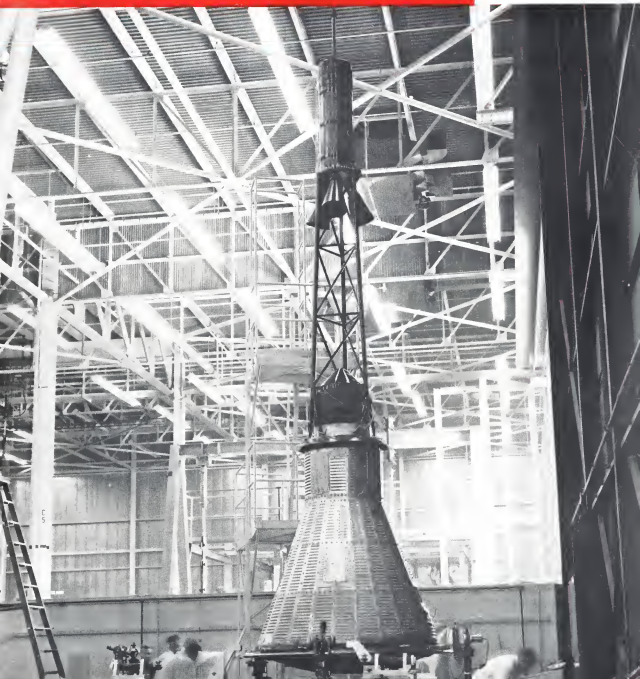
*and Space Technology*

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Attainment of criticality by the Gas-Cooled Reactor Experiment in Idaho is a step forward towards compact, transportable nuclear power plants. The facility is to test advanced concepts for mobile power reactors was designed and developed by Aerojet-General Nuclear Inc., San Ramon, California, and the Aeronautics Division of Aerojet-General Corporation, for the U. S. Atomic Energy Commission. As systems contractor for the Army Gas-Cooled Reactor Systems Program, Aerojet is designing the world's first mobile power plant.

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Rocket propulsion system equipment

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Transformer power supplies

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— D. S. Supreme Court

### AVIATION CALENDAR

Apr. 26-Mt. Rushmore Comm. Station  
Celebration, Mammoth Airport, Montana  
Apr. 27-28-National Meeting on Space Age,  
Marquette, Wisconsin. Chapter of the  
American Society for Methods, Services  
Globe Hotel, Cornish, Ohio  
Apr. 28-29-1964 Annual Meeting, American  
Tool Training Society, Mayfield Hotel,  
Washington, D. C.  
Apr. 28-29-Rajasthan Quarterly Meeting  
Assn. of Local Transport Services, Wis-  
sack Hotel, Philadelphia, Pa.  
Apr. 28-29-Response to "Global Control  
Response System", Wright Air Devlop-  
ment Division, Wright-Patterson AFB  
May 1-4-1964 Annual Meeting and News  
Conference, American Women Assn., Los  
Angeles, Calif.  
May 2-4-National Association of Electronic  
Coordinators, Baltimore and Mount  
Park, North Carolina. Ohio Space  
Institute of Radio Engineers  
May 2-8-86th National Flight Test Sym-  
posium, Indusnet Society of America  
San Diego, Calif.  
May 3-Spring Meeting, Eastern Division  
Society of Aerospace Materials and Pro-  
cess Engineers, Massachusetts Institute of  
Technology, Cambridge, Mass.  
May 4-Properties and Application of  
Materials in Aerospace Vehicle Design  
Symposium, Park Lane Hotel, Denver  
Colo. American Thor Motor Co., Denver  
May 9-11-1964 Annual Meeting, American  
Medical Assn., Americana Hotel, Las Vegas,  
Nevada  
May 9-11-1964 Symposium of the Insti-  
tute of Radio Engineers, Professional  
Group on Electronic Theory and Tech-  
niques, Hotel del Coronado, San Diego  
May 9-12-36th Annual Meeting and Air-  
craft Symposium, American Society for  
Aeronautics, Hotel Los Angeles  
May 9-12-1964 International Aeronautical Con-  
gress and Exposition, American Society  
(Continued on page 6)

### AVIATION WEEK and Space Technology April 15, 1964 Vol. 72, No. 16

AVIATION WEEK and Space Technology is a leading authority on the latest developments in the field of aviation and space technology. The magazine is published weekly and contains a wealth of information on the latest news, research, and developments in the field. It is a must-read for anyone interested in aviation and space technology.

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## Engineering notes from the SMI REPORTER

by STANLEY M. INHERSOLL, Capabilities Engineer



### Report No. 4

#### AXC 620 Miniature True Airspeed Computer (Minimax)

Exceptional accuracy and small size are key features of SMI's new Minimax True Airspeed Computer. Any one of three true airspeed measuring means and associated data be supplied to meet the requirements of high performance aircraft, patrol planes, helicopters, artillery-directing aircraft, and missiles. The MINIMAX consists of an extremely sensitive and accurate force balance Mach transducer, a pressure resistance network, and a follow-up servo. The transducer is made up of a pressure ratio sensor — which is the heart of the system — a servo, and an electrical hysteresis generator. All servo amplifiers use silicon transistors for uniform reliability in severe environments. The MINIMAX is capable of operation in a 25°C environment and requires only 20 watts of 115 vac, 400 cps power. Without checkwheels, the computer measures 5" dia. x 5 1/2" x 8 1/2" and weighs 6.5 lbs. The MINIMAX conforms to MIL-E-6400 and MIL-E-6272.

#### Typical Performance Specifications

TYPE NO.	TRUE AIRSPEED RANGE (KNOTS)	ACCURACY (PER CENT)	WEIGHT (POUNDS)
AXC 620	20 to 400 125 to 175 125 to 400 400 to 400	± 0.50 ± 0.50 ± 0.50 ± 0.50	± 6.5 ± 6.5 ± 6.5 ± 6.5

NOTE: Tests on certified aircraft showed accuracy on various test conditions. Accuracy on other aircraft may vary. Also available: AXC 621 and AXC 622 are capable of operation up to 4000 ft. with reduced accuracy.



FIGURE 1. SCHEMATIC—AXC 620 Miniature True Airspeed Computer

For more information and complete operating specifications, write or wire SMI today. Address your inquiry to Stanley M. Inherisoll, Capabilities Engineer.



SERVOMECHANISMS INC.

Los Angeles Division  
100500 Aviation Boulevard  
Northridge, California

(Continued from page 5)

Metals Division Dallas Hotel and  
Suite Inn Fort, Dallas, Tex.  
1911-1912 Annual Conference, Society  
of Biological Scientists and Engineers  
Marine Hotel, Los Angeles, Calif.  
1912-1913, Electronic Components  
Conference, Willard Hotel, Washington  
D. C. Sponsor, Institute of Radio Engi-  
neers, Professional Group on Component  
Parts, American Institute of Electrical  
Engineers, Electronic Industries Ass.,  
Western Electronics Manufacturers Ass.  
11-14-1916 Annual National Forum,  
University Biological Society, Houston

(Continued from page 5)

for Motels, Sheraton Dallas Hotel and  
Jesse Vinn Park, Dallas, Tex.

May 9-11—Annual Conference, Society  
of Photographic Scientists and Engineers  
National Meeting, Los Angeles, Calif.

May 18-12-1956, Electronic Components  
Conference, Willard Hotel, Washington  
D. C. Sponsors: Institute of Radio Engi-  
neers; Professional Group in Component  
Parts; American Institute of Electrical  
Engineers; Electronic Industries Assn.,  
Western Electronic Manufacturers Assn.

May 11-14-1956 Annual National Forum,  
American Photographic Society, Sheraton

[illegible]

May 26-27: National Symposium Meeting on  
Gardens of Annapurna Valley, India, at  
the Annapurna Institute, Hotel Saur  
Hotel, Kathmandu, Nepal.

June 14-18: 1975 Young-Astronaut Distribution and Manufacturing Assn., Queen Elizabeth Hotel, Montreal, Canada  
June 20-23: 1976 Annual Meeting, Institute of Navigation, Ft. Collins, Colorado  
June 27-30: 1976 National Convention on Military Electronics, Institute of Radio Engineers, Sheraton Park Hotel, Washington, D.C.  
Aug. 1978-1979: 1978 Annual Congress International Astronautical Federation, Royal Institute of Technology, Stockholm

Sept. 23-28—Western Electrical Show, 3 Convention, Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.  
Sept. 5-11-1950 Fairborough Flying Display and Exhibition, Society of British Aircraft Constructors, Fairborough, Eng.  
Sept. 12-16-1950 Annual General Meeting IATA, Copenhagen, Denmark  
Sept. 23-25—National Convention and Aerospace Phoenix, Air Force Ass., Cox Auditorium and Shrine Hall, San Francisco, Calif.

STANDARD SIZES						
STYLE A		STYLE B		STYLE C		
PART No	MPD	L	E	D	STYLE	
1236104	04	150	425	625	A B	
261	1	150	475	675	A B C	
261	25	750	1400	1600	A B C	
461	5	1625	1400	2000	A B C	
561	10	1600	2125	2125	A B C	
661	10	1600	2350	2350	A B C	

Designed for integration with high-temperature microfilm/cassette components, this several addition to Airborne's line of monolithic capacitors offers a working temperature range of -65 to +200°F—without voltage derating and with low component weight.

As a defense for this new Auto-therm capacitor, we use a variety of its pure facts—because most materials in thermistors fail at temperatures well above XOPF. The conductor is aluminum foil, and the completed winding is encased in a thermally stable, low moisture absorption resistance. A new capacitor spray technique has also been developed to provide high-temperature and low coefficient for minimal a special ceramic is used. These and other refinements make the capacitor more suited for the extreme environment.

If you have requirements in high-temperature miniaturized capacitors, consult Airborne Wadsworth Corporation; we offer metallized Mylar® and Teflon® types—note, as well as Airborne capacitors, for their electrical and mechanical reliability. Mylar is recommended to 300°F, Teflon to 400°F. Contact any of our offices or write for Product Bulletin PB-66.

**STANDARD CHARACTERISTICS—**  
**ADSORBENT HIGH-TEMPERATURE MOXA CAPACITORS**  
 Temperature: -55 to +70°C  
 Rated voltage: 300 VDC  
 Life: 100 to 10,000 h @ 140 VDC and 70°C  
 Capacitance tolerance: 10%, 50%  
 Dissipation factor: 0.001 (max temp.)  
 10,000 mhos/cm<sup>2</sup>/h @ 50°C  
 70% PwT, 10% for its polymeric film  
 100% PwT, 10% for its intercalated-substance  
 values  
 50°C PwT, 10% for its internal resistance  
 values



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integrated programs of research & development  
of electronic systems and components.

The new Barnes-Woodbridge Laboratories in Canoga Park provide an environment for creative work in an academic setting. Here, scientists and engineers seek solutions to the technological problems of today. The Barnes-Woodbridge research and development philosophy places major emphasis on the imaginative contributions of the members of the technical staff. • There are outstanding opportunities for scientists and engineers. Write Dr. Richard C. Potter, Head, Technical Staff Development, Department M.D.,

◆◆ THE RAMO-WOOLDRIDGE LABORATORIES



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 HILLSIDE 5, NEW JERSEY • Offices in Los Angeles and Dallas

# Barber-Colman temperature control systems help assure business travelers complete comfort aboard the newest in corporate craft

All of these advanced additions to the nation's business aircraft fleet — Aero Ali-Cruiser, Beechcraft Queen Air, Fairchild F-27, Grumman Gulfstream, Lockheed JetStar — have this in common: the cabin temperature control system is by Barber-Colman. And several use Barber-Colman controls for other functions such as anti-icing, cockpit temperature control, and pressure or air regulation. In addition to the aircraft shown here, many conversions of the B-26, DC-3, D-18, Lodestar, and other aircraft also incorporate Barber-Colman temperature control systems. Thus, whenever and wherever businessmen fly on today's newest corporate craft . . . as well as commercial airliners . . . most likely they are traveling on Barber-Colman equipped airplanes that provide living-room comfort every mile of the way.



**FAIRCHILD F-27**

Equipped with Barber-Colman cabin temperature control system and Barber-Colman actuator for pressure regulator valve.



**LOCKHEED JETSTAR**

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**AERO COMMANDER  
MODEL 790 ALTI-CRUISER**

Pressurized version of Aero Commander. Equipped with Barber-Colman cabin temperature control and windshield anti-ice system.



**BEECHCRAFT QUEEN AIR**

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**GRUMMAN GULFSTREAM**

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Barber-Colman temperature controls, electric windshield controls, or valves assure comfort on DC-8, Electra, 707, and F-27 commercial airlines as well as leading business aircraft.

Barber-Colman Company offers complete coverage of the aircraft and ground support temperature control field cycling—proportioning—floating; electronic . . . semi-conductor . . . polarized relay . . . and megasec amplifier types for business, commercial, and military aircraft. Let us work with you on the design of a system best suited for your application. Consult the Barber-Colman engineering sales office nearest you: Baltimore, Boston, Fort Worth, Los Angeles, Montreal, New York, Rockford, Seattle.

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see facing page for other aircraft equipped with Barber-Colman temperature controls

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SILICONE NEWS from Dow Corning

## Sealing Zero...and 500 F



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Cheyder Missile Division engineers specify Silastic®, the Dow Corning ethylene rubber, for flexible ducting, access door seals, and other applications on the Army developed Jupiter IIRSM.

**Why Silastic?** In the first place, of course, because this material has excellent resistance to extremes of temperature. From below -130 to 500 F, it remains rubbery and flexible. Recovery temperatures far exceed 600, but Silastic survives for the brief period of time involved, whereas conventional rubber wouldn't.

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**Dow Corning CORPORATION**  
MIDLAND, MICHIGAN

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Silicone was specified for the Jupiter's numerous temperature access door seal. The Silastic seal has better elongation properties and can better stand high die temperatures. It is harder than the conventional seal under stress.

In the cooling system for Jupiter's numerous components, low pressure liquid nitrogen vapor is cooled by these ducts. Made of Silastic and aluminum, they're light in weight, and are designed to meet specs of -75 to 400 F performance.



Also, Silastic resists the effects of storage and weathering. Sample parts have withstood 9 years weathering at Florida test stations without measurable change of properties. This is equivalent to over 35 years of exposure under average design conditions. Other reasons why missile designers specify Silastic include resistance to moisture, acids, solvents, many fuels and chemicals.

For further data, write dept. 0904.

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The LWB 902 offers substantial weight savings over previous 220,000 psi bolts... without sacrificing mechanical strength or fatigue properties. Result: Fewer bolts are needed, heavier bolts can be replaced.

The reduced size of the bolt head allows closer installation to perpendicular bulkheads, with resultant structural weight savings. What's more, the design of the bolt provides a fastener compatible with the newer, high-strength elevated temperature materials.

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**Characteristics of the LWB 902:**

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For complete technical data on the LWB 902 and the FN 902 visit our new Website [www.sps.com](http://www.sps.com)

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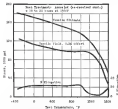
*Space cold*



*Re-entry hot*

## INCONEL "X"...

### when you want sheet with range



Typical tensile properties of age-hardened Inconel "X" alloy sheet. Note strength at high and low temperatures. Much higher strengths are the additive effects of cold work and age-hardening.

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- High impact strength down to liquid oxygen temperatures
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# INCONEL "X"



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# W



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Get watts from sunlight for a satellite's flight?

*We've a  
good mind  
to do it at*



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The concept is simply stated—direct conversion of solar energy.

But the execution is complex.

For the satellite's power system must be light to conserve rocket thrust...

It must be compact—essential communications, weather, photographic or other instrumentation puts a premium on room...

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Result: A compact, efficient, virtually foolproof, 100-watt to 1,500-watt solar thermoelectric system 50% to 65% lighter than other systems.

And direct conversion is but one of many areas of inquiry we're putting our minds to at Allison. We're aided in our efforts by our Scientific Advisory Committee, American and European consultants, plus every resource General Motors possesses.

Whether your problem is concerned with the heavens, the earth, or the oceans, Allison has the will and—if it can be solved—the way to solve it. We're doing it for others, we could do it for you.

*Illustrated is an experimental thermoelectric generator module for the direct conversion of solar heat to electrical energy. A special bonding technique effects the thermoelectric junction between iron and lead telluride.*





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temperature  
detectors  
meet or exceed

## MILITARY STANDARDS

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Designed for such applications as the measurement of cylinder head temperatures, tube oil temperatures, and rocket fuel temperatures, these rugged detectors offer unmatched accuracy, sensitivity, speed of response, and give years of maintenance-free service.

In addition to the Military Standards, Edison offers a wide variety of detectors for special purposes. Years of experience in the manufacture of temperature detectors for new and difficult applications provide Edison engineers with the ability to design and fabricate special detectors to meet your most exacting requirements.

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## EDITORIAL

### Pentagon White Paper

In response to the sustained and apparently effective public criticism of its defense program, the Pentagon has belatedly drafted a comprehensive statement of its position and is circulating it quickly among about 600 leaders of American public opinion. This Pentagon White Paper is on the form of a 17-page document relying to quotation noted by Carter Burges, president of American Machine & Foundry Co., who was formerly an Assistant Secretary of Defense in the Eisenhower Administration and is now active in American Legion defense policy groups.

This document is representative in embodying "the combined thinking of the Secretary of Defense and his principal military and scientific advisors," and it also has been stressed through Manny Serber's security review. It is signed, not by Secretary of Defense Thomas Gates, who would normally be the Administration policy spokesman on defense, but by Oliver Gale, who came to the Pentagon from Procter & Gamble with Neil McMillan and has not yet followed his boss back to Cincinnati.

This Pentagon White Paper is a useful contribution to the great national debate now raging over the adequacy of our military posture. For this is the first time the Administration has come out from behind its "defense-know-nothing" attitude and attempted to debate its military policy on specific matters. It is an open debate of this type that democracy depends for its survival. Without full public debate on the defense issue, it is difficult for the American people, who are the ultimate judges of these policies, to receive an effective verdict. In the Pentagon White Paper the public now has its first telling of how the Administration views its defense program.

Because of the importance of this document as the first defense, and despite the fact that we disagree with most of its contentions and challenge the accuracy of many of its statements, *American Weekly* will publish the full text of this document next week. We believe it should be read and studied by many more Americans than the 600 selected by Mr. Gale. In that case we can challenge only a few fallacies expressed in this document and point out only some major omissions.

Perhaps its most fundamental error is the premise that the defense debate has been confined to a single weapons-the-missile-and-bombers-and that defense critics condemn our national security depends solely on matching the USSR in numbers of these missiles.

Actually, the defense debate has ranged along a far broader front, including the shocking lack of modern weapons for ground troops, inadequate military airlift, neglect of our submarine warfare developments, production of our stock of the heavy bomber and jet bomber programs and inadequate research and development as well as the gross underestimation of ICBM requirements for the next four years.

The White Paper ignores completely the most important change that the defense program is actually making in a budget which rather than voluntarily needed to meet the changing military threat and then could accordingly. The White Paper contends that, while ICBMs are an ideal weapon for the USSR, they are not a good option for this country, and we should place greater reliance on manned bombers.

The paper then presents a very picture of our manned bomber fleet, which points out all the budget-drafted scheme in the past few years that have whittled down our real potential in this field.

It ignores the major setback in the B-52 bomber and KC-135 jet tanker programs that will leave Strategic

Armament with only about two-thirds of its requirement in this area. It ignores the production setback on these two aircraft that has significantly delayed the date when SAC will reach its current authorized B-52 and jet tanker strength. It ignores the shockwave of the B-47 fleet, which is still the main SAC force, and it fails to mention the setback and setback on the B-54 program that is dividing this weapon system along at a rate that threatens to impact its overall effectiveness.

In discussing the inherent alert problem, the paper states flatly that there are no problem and that present personnel will give us an airborne alert capability which we need. This is at variance with the testimony of the men who have responsibility for really producing an airborne alert capability.

The paper's statement that there are always some SAC aircraft in the air with nuclear weapons, always technically correct, is a great deal of comfort to the public when it comes to alert capability that does not come out and well out until the current defense program is expanded to hold it. In its apology for the B-70 program setback, the paper lacks the obviously contradictory weapon system as being simply too expensive with the Atlas, Titan, Minuteman, and Polaris to do "a single percent more." This flexibility provided by the B-70 type cannot process is completely ignored despite the earlier statements that this country should depend on manned systems rather than ICBMs.

Perhaps the most glaring individual error in its B-70 discussion comes from the blind observation that a Mach 3 bomber will present no appreciable more difficult problem to us as defense system than a Mach 2 airplane. We suggest that the USSR air defense program might have a slightly different view of this matter.

It also is interesting to note the type of logic that runs through the entire paper in that particular situation. It says we are nothing back the B-58 program because there is apparently not much requirement for a Mach 3 bomber, and then we see that the B-58 program is the Mach 3 bomber on the grounds that it won't be much better than the Mach 2 bomber that we aren't getting in any significant quantity either.

In the ICBM discussion, the logic goes even more to the point. The paper admits we could have built more than 1000 in the USSR missiles for the cutoff 1962-64 period if we desired. It says "sound strategic reasoning led us to choose not to produce as many of these Intercontinental liquid-fueled, hard-to-use missiles as we estimated the Soviets could produce." It then states the report returns by the Pentagon to assist the Atlas and Titan programs twice within the last six months, the members of this "strategic reasoning" that determined the original maximum ICBM program was to open to dispute.

The paper also dwells over the current lack of ICBM operational capability, with the notation that "operational Atlas missiles are ready for launching from the West Coast." Consequently ignored is the fact that that capability actually stands at less than one to its nominal, depending on circumstances.

After careful study of this White Paper and comparison of its more claims against the actual record, it is clear to understand how the Defense Department gets so tangled in its planning and execution. It also starts the thought that if the White Paper really represents the Defense Department thinking we are in worse shape than previously imagined.

—Robert Hottel



STEPS IN THE RACE TO OUTER SPACE

## Breaking a Space Traffic Jam

By 1970 our solar system will be filled with expanded satellites—moving slowly in space with clock-like precision and electronic computers at their missions long since completed.

As space traffic increases, these cars will have to be captured and broken out of orbit to keep flight paths clear for their tasks. Special launchers will be designed and directed toward.

Next, step by step, is an account of such satellite capture and destruction:

1. The low-speed driver by variable particle propulsion, reaches into space at speeds reaching 25,000 m.p.h. Its approach is guided by radar or by a computer.

2. The satellite's speed is increased and its orbit lowered.

3. The low-speed driver is then switched to full reverse and the low-speed driver gradually loses momentum, moving into a spiral path toward the Earth below.

4. When a safe point is reached, the low-speed driver releases the satellite and it is captured by the satellite.

5. The satellite, carrying its speed, enters on its last assignment—breaking a traffic jam in some other congested point in space.

6. The low-speed driver, now providing the inertial guidance system for the ATLAS 1000 and engaged in advanced research and development, is in the vanguard of the race to outer space for the effort.

7. The low-speed driver reaches the satellite and it is captured by the satellite.

**AMERICAN BOSCH ARMA CORPORATION**

## WHO'S WHERE

### In the Front Office

Gen. Alfred M. Greiner (USA, ret.) and Willie G. Lippert, director of the American World Airways. Mr. Lippert continues as Pan Am's vice president and chief pilot.

Paul J. Boush and Thomas F. Robertson, vice presidents, Bristol International Airways. Also Roger Bennett and O. Robert Frost, Jr., assistant vice presidents.

Ronald C. Caldwell, vice president, administration, Lockheed Electronics Co., Pleasanton, Calif.

Don E. Belsky, vice president of Boeing Aircraft Co. and vice president general manager of the Vostok Division, Moscow. Dr. Sir Ronald Vinton Smith, chairman of Boeing Aerospace, and G. H. Chelton Smith, chairman of Fairchild Aircraft, director of research and development, Fairchild Aircraft Co., New York.

John E. Belsky, chairman of the board, director of Lockheed Aircraft Co., New York. Dr. J. E. Belsky, chairman of the board, director of Lockheed Aircraft Co., New York.

Robert E. Dwyer, vice president engineering, Pratt & Whitney, Inc., Hartford, Conn.

Gen. Alfred M. Greiner, vice president and general manager, American World Airways Corp., New York. Also, a division of The Eastern Air Lines Co.

Z. W. Page, vice president marketing, Hughes Electronics Corp., Los Angeles, Calif., and Donald C. Smith, general manager of the new Hughes Electronics Division.

John H. Kellie, chairman of the executive vice president, Boeing and Ray, Inc., New York, N.Y.

Gen. H. D. Milam, director of research and development, Boeing Co., Seattle, Wash. Also, Boeing Aircraft Co., Seattle, Wash. Also, Boeing Aircraft Co., Seattle, Wash. Also, Boeing Aircraft Co., Seattle, Wash.

Dr. H. D. Milam, director of research and development, Boeing Co., Seattle, Wash. Also, Boeing Aircraft Co., Seattle, Wash. Also, Boeing Aircraft Co., Seattle, Wash.

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## INDUSTRY OBSERVER

► National Aeronautics and Space Administration Atlas Able V launch vehicle is now scheduled for launch from Cape Canaveral, Fla., on Aug. 25 and Nov. 14. Payload capacity and weight—372 lb.—remains essentially the same as that originally planned, but very low frequency radio signal detection equipment has been substituted for a Space Technology Laboratory simulation experiment and a plasma probe. Air Force's Ballistic Missile Defense Command Atlas ICBM will serve as the launch. Upper stage is Air Force's boost-boost-boost AF1B and Allagany Defense Laboratory's solid propellant AR1-245.

► Centaur Jr., an 841 lbm, hydrogen-oxygen rocket stage using one Pratt & Whitney MLR 115 engine, has been proposed for use on test of Athena-Centaur and Saturn space vehicles. Stage would offer some advantages over conventional-liquid Athena-Centaur. Full stage Centaur, built by Convair for NASA and USAF, uses two MLR 115s. Several engine companies are interested in building Centaur Jr.

► Soviet Mi-4 helicopter which has been brought to this country will undergo a very complete flight evaluation at Air Force Flight Test Center, Edwards AFB, Calif., within the near future. Machine already has been completely torn down and all parts, components and systems thoroughly analyzed from design, manufacturing and service standpoints. The helicopter has now been assembled for the flight program.

► Army Ordnance plans to develop a short-range short-range missile tentatively designated "Auto-Mer" because its guidance system is expected to automatically compensate for local meteorological conditions and enable the vehicle to fly a pass ballistic trajectory. New missile is a successor to "Mole" "A," tactical version on which industry had Army, however, never awarded a contract. General Electric is favored to get the contract for development of "Auto-Mer" missile system, and perhaps the guidance.

► Chance Vought Aircraft has proposed a plan to Navy for conversion of B-70 F-105F aircraft to Mach 2.5 speed through airframe modifications and installation of new engines. Conversion was a few months ago. The conversion at the time on that quoted by McDonnell Aircraft for 30 F-105F Mach 2.5 speed all-weather fighters.

► Japan's Maritime Self Defense Force has contracted with the U.S. to obtain Navy's Chaparral air-to-air missile system for its shipborne guided missile program (AW Feb. 15, p. 35).

► Air Force has requested approximately 15 companies to submit estimates of their capabilities of applying hydrazine in quantity through 1965 in connection with Marine Corps (ICBM) operational and strategic requirements.

► Cassin per certain area of the U.S. that could be hit by Soviet ICBMs without being detected by the BMEWS alert is Greenland or Alaska is responsible for Air Force request for an additional \$450 million to expedite construction of the third BMEWS site in Britain to the present level. There are no increasing speculation that Soviet's extremely long-range ballistic missile may prompt the U.S. to seek additional BMEWS sites in Africa and Australia to protect the northern approach.

► Chance-Vought Propeller Division has received a \$3 million contract from Wright Air Development Division for development and flight test of an all-weather flight control system. Power for the system is taken from an engine just through a spring wind-up mechanism and transmitted mechanically to the wind-up mechanism outside. System will be flight tested on a North American F-100.

► Limited experiments on behavior of fluids under zero gravity indicate that dispersions or droplets of some type may be necessary to push fluid mass into fast lanes when rocket engines are under weightless conditions in space.

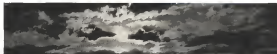
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and design engineers. Glendale, Calif. ■ Information on employment opportunities, address Glen Seltzer,



computers that pace man's expanding mind



## Washington Roundup

### Defense Budget

House Appropriations Committee is expected to substantially boost the 591 sub-item proposed by President Eisenhower as the Fiscal 1961 budget for long lead time items for a Strategic Air Command airborne alert, has more closely toward the accelerated policy advocated by SAC commander Gen. Thomas S. Power. Vote on Fiscal 1961 defense budget is scheduled for Apr. 29.

Obstruction of the committee probably will gradually follow Administration requests was that a revised program has been submitted for acceleration of Air Force's Convair A-10A ICBM and Navy's Polaris fleet ballistic missile (AW Apr. 31, p. 17).

There is still strong opposition within the committee to Air Force plan to boost the force and a second journal of the Marine Corps ICBM, pushing the operational delay of cost of the 34 airplanes into 1962-63 era of the, what might be Marine's Ray C. Clegg, Major (D-Tex.) chairman of the Defense Appropriations Subcommittee, says, however, that "the Air Force wants this with the program, and I hesitate to report on judgment."

### Homer Replacement

Watch for replacement for Richard E. Homer as member three men at the National Aeronautics and Space Administration to be selected from outside the agency. Homer is expected to leave for an industry job about July 1, and his successor probably will be given only an acting appointment.

NASA Administrator T. Keith Glennan, who intends to return to the presidency of Case Institute of Technology after the November elections, will give his successor the option of assuming a permanent scientific administration.

Glennan, former assistant secretary of the Air Force for research and development, had planned to go to industry before accepting the NASA post last summer, finally agreed to serve with the agency for one year.

Rate of decline in aeronautical research by National Aeronautics and Space Administration (AW Apr. 14, p. 32) continues to accelerate. Ratio of research on manned aircraft was 68% two years ago, 58% a year ago. Now it has declined to approximately 25% of the expenditure, time and money being expended at NASA's three main research centers—Lewis, Ames and Langley.

### Saturn Secrecy

Meanwhile, once closely held secret since NASA was created has been the winner of the S-4 engine competition and the 200,000-thrust hydrogen engine competition for the Saturn space vehicle. Airframe and rocket engine companies all need secrecy, all want the program connected with their respective space methods.

That secrecy is in the past, intense industry rivalry, a succession of political lobbying from the satellites. Airframe winner could cash win advance contracts for two other large Saturn stages. Engine winner will produce a total of six engines for each final version of the Saturn (see p. 26).

Secrecy selection launch and NASA headquarters personnel have been extremely careful to prevent premature leaks. Contractors in the race have attempted.

"Institutional free lag" in military scientific, after technological developments to defense and foreign policy will highlight hearings late this month in a Senate subcommittee on national policy mechanism. Subcommittee, headed by Sen. Henry Jackson (D-Wash.) complains that military planning is too slow in recognizing the impact of new technological discoveries. State Department too is, offering policies as to the type of military program needed to best implement foreign policy.

### Durfee Replacement

While House will name a member of its own staff in 60 out of the unexpired term of Civil Aeronautics Board Chairman James Durfee when he comes out to accept a presidency on the Federal Court of Claims. Then it is due to expire Dec. 31, shortly after the November elections, just before a new President steps in.

Senate membership is now scheduled to vote on Durfee's Court of Claims appointment most important that week. His main opponent Sen. Wilver Fournier (D-Wash.) claims to have secured the support of several other senators in his opposition to Durfee, but the Senate is expected to vote favorably on the appointment.

Action on the appointment has been delayed thus far primarily by the civil rights battle.

Signs that the two-headed General Posture Fire Investigation may be heading for a place in its four-year life when a final decision is forthcoming are increasing. But estimates now place the date of decision at sometime next month.

—Washington Staff





Agency. Navy will be awarded operational control of the system, and last week's launch probably will accelerate the transfer date, which may be made within the next two months.

#### Spin Deceleration

Spin rate of the Transit 1B vehicle is scheduled to be slowed to a near stop two weeks, seven days after its April 11 launch, by two weights launched and centrifugally opposite one another along the sphere's mid-section.

The weights, their attaching cables wound around the sphere in a diametric opposition that of the satellite's internal spin, will be automatically ejected by a decontaminating timing device scheduled to operate during the seventh day of orbit. Upon unspooling, the weights will establish a counterbalance to retard the satellite's rotation. Present spin rate is about 1 rpm. Once the rate is slowed, the vehicle's rotation will be sustained by an alternate system contained in the payload.

In operational version of the Transit, spin of the satellite will be retarded almost immediately after orbit is attained. The present vehicle is being permitted to continue spin for one month, period to accommodate a "pogo-bug" experiment to probe the infrared attitude level of the earth. Experiments are being designed to provide additional data pertaining to the earth's heat balance.

The 1B vehicle is the first of three 265-lb test vehicles Applied Physics Laboratory scientists believe they need to put into orbit before the Navy's operational system of at least five 50-lb

satellites can be effectively placed in orbit at the same time.

Primary mission of the 1B will be to determine the effects of ionospheric refraction of radio waves in connection with the doppler shift measurements that will be used in obtaining precise navigational fixes, and to improve the accuracy of geodetic measurements of the earth's shape and distances between land masses.

The payload contains two ultra-stable oscillators based on Deuterium-tritium isotopes, each of which is resonating on two frequencies at continuous intervals. Power for one of the oscillators transmitting at frequencies of 54 and 52.4 megacycles is being supplied by a double bond of solar cell panels at the center of the satellite. The second oscillator is driven by a supply from nickel cadmium batteries and transmits at 162 and 216 mc. It is needed in the first vehicle to be sustained by a passive data for the operational studies.

It will not be used, however, in the operational system where two frequencies can be sufficient to measure doppler shift.

The Transit 1B is now being tracked by six stations. Locations are Applied Physics Laboratory, near Washington, the University of Texas, University of Washington, University of New Mexico, Argentina, New Brunswick, and the Royal Aircraft Establishment at Bedford, Hants, England.

By early 1967, when the initial experimental versions are launched, Navy hopes sufficient satellite data will be obtained to question concerning the re-

#### Typhon Missile System

An Anglo-American code for Navy's Typhon advanced air defense missile system will be developed and produced by Westinghouse Electric Corp. under a \$18.5 million license of Westinghouse contract for operational service after 1967.

The third year Typhon will be contracted to Johns Hopkins University's Applied Physics Laboratory, Ford, electrically assisted version of the present radar will be replaced in a very high frequency radar system. The radar will be installed aboard destroyers, frigates and cruisers. Eventually, ships will be designed from the keel up for Typhon systems.

A single Typhon radar can handle multiple airborne targets without need for beam tracking radar. A Navy spokesman says that the Typhon system is not planned to defend against incoming SAMs, weapons that will be needed against Soviet ballistic missiles and high performance aircraft.

Typhon is regarded as a true point defense system, rather than the first important step beyond the "humble" radar located on the ship's deck. No clutter has been let for any other part of the system. The missile itself is to be more potent and smaller than Talo.

Reaction effects of the ionosphere and the gravitational forces to which the vehicle will be subjected to prevent the navigation system will have been tested by the doppler tracking system located within the central U.S. As additional status to complete data received from the system and to correct the orbit, additional status in the vehicle's navigation system every two days also will be required. All air stations will be required to do this.

#### Additional Tests

First of two additional test vehicle launches now planned probably will be made sometime in May. Data and information of the Typhon system will be obtained from the test.

A high-altitude version of the system is planned to study the effects of the ionosphere on frequency measurements and to verify theories that corrections can be made to compensate for the ionospheric effects of the ionosphere.

A low-altitude orbit around close to the equator to study the effect of gravitational forces to which a satellite is subjected and to test proposed data on the shape of the earth. The information can be used to correct tracking stations can be based upon the data received U.S. To aid in the precise navigation, Navy and Applied Physics Laboratory hope to establish a network of 10 data-collecting stations at sub-

tropical points around the earth within the next 12 months. However, negotiations for their establishment are still under way with the various involved. Navy and Applied Physics Laboratory scientists are now before the Pentagon to make plans, the satellite's use from the present 265 lb to approximately 50 lb will present serious problems.

The operational version will be completely powered by solar cells, and the relatively heavy chemical batteries that power the expendable isolator in the test version will be removed. The isolator will be replaced by a transistorized isolator. In addition, the test satellites also contain a quantity of backup equipment that can be checked.

Once the weight reduction is achieved, Navy will switch from the latest Thor-Able Star booster, which has a first-stage thrust of 118,000 lb, to a lighter, relatively inexpensive system, probably a variation of the NASA Scout, under development by Chrysler-Vought Aircraft, Inc.

Under present planning, four of the operational Transit satellites will always be in orbit—two at an inclination of 67.5 deg, to the equator, the other two at 180 deg, two at mean 25 deg inclination and also 180 deg. All four will be launched from Cape Canaveral.

Such a system would permit satellite orbits to obtain programmed functions approximately every hour and a half and would cover all areas of the earth except those in the extreme polar regions and in the immediate vicinity of the equator.

To provide complete coverage, Navy scientists are "urgently" finishing of requesting funds for an additional two satellites—one with a polar orbit, the other covering the equatorial region.

Optimum altitude for the satellite system will be approximately 500 mi, according to Dr. R. R. Kershner, head of the Transit project at Applied Physics Laboratory.

Such an altitude is high enough to minimize the effects of the earth's gravitational pull and low enough to keep the satellites below the bands of the Van Allen radiation belts.

Dr. Kershner says the transmitter of the operational satellite system should ultimately attain a lifetime of about five years. It also, eventually, the Navy will be required to develop a way to use a satellite a year into orbit to maintain the rate of four measuring vehicles.

With the four satellites in orbit, new test of maintaining the first tracking stations is being a necessary. The satellites is estimated at approximately 55 million a year.

The satellites will be automatically queried twice a day at its first pass

about. This information will then be relayed back to a receiver and within eight minutes which, in turn, will transmit its orbit position and a time signal on a secure-minute basis at it strikes the earth's surface. Cape Canaveral.

Necessary computers to obtain accurate fix to within one-half of a mile probably will be too heavy to be incorporated into any existing aircraft, according to Dr. Kershner. He says, however, that aircraft should be capable of carrying a computer system that would provide a "low accuracy" that a rifle target is that accurate with present systems.

If the system proves out, the Navy probably will seek the property, if not all, of its other ships with the computer system needed to obtain precise navigation. But the system is estimated to be over that of present Long approach.

The frequency changes in the signals of the Transit 1B are being checked automatically by Applied Physics Laboratory system against a time and frequency standard. The information is then relayed to an APL computer center where the satellite's position can be continuously plotted by a Transit 1B1A high speed digital computer.

State department in a direct manner of the rate of change of distance between the transmitter and the receiver at a known location on the ground, the rate of change of the satellite can be calculated because its orbit is governed by orbital mechanics.

Transit 1B does not contain the receiver system, which is still under development by Applied Physics

Laboratory and because of the difficulty in obtaining the necessary measurement, it probably will not be available until late for the launch of the third test vehicle later this year. The current development of ASW second stage indicates a number of substantial changes, both in integrated into the stage by Space Technology Laboratories, including the external electronic instrumentation, ranging units, guidance and attitude control units, a propulsion and an accelerometer.

The payload spin and separation mechanism, also provided by STL, will be mounted on top of the second stage and also serve as the payload shutoff device.

Weight of the second stage is over 1,000 lb, length 14 ft 10 in, diameter 18 in. It is fired and oxidized with the ASW-8000 is substituted rocket engine and also uncontracted electrical systems.

Airframe control during non-powered flight is accomplished through eight small control wheels through gyro, roll and yaw.

Last week's launch was the second attempt to put a Transit test vehicle into orbit. The first ASW-8000 launched from Cape Canaveral (AW Sept. 21, p. 36), did not go into orbit when the third stage of the Thor-Able booster failed to ignite.

The satellite reached an altitude of 400 mi. However, the test mission was terminated during the 35 min. of flight. Data from the short flight, according to the Navy, led to preliminary determinations that orbital corrections are feasible.

## Douglas Develops ASW Computer

Santa Monica, Calif.—Douglas Aircraft Co. is developing an airborne computer system designed to give a submarine detection capability to fighter and attack aircraft which do not normally carry ASW search and local mission equipment.

The system, still in the early design stage, is being developed under a \$1.5 million Bureau of Weapons contract in the Visual Aids Laboratory, which is being used to pinpoint a submarine's position once its general location is known.

Designated ASWAD, for Active Airborne Search Data Analysis, the system would be carried internally in pod form to receive and interpret signals from ASW searchers, displaying position signals and computing location.

In the future concept, a ring of active listening stations is being a necessary for low-altitude aircraft. The planes then drop a series of small balloons in the sea, and the return echoes from the balloons are transmitted from the balloons to

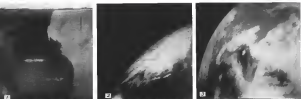
the search aircraft. In conventional ASW search and patrol aircraft, the echoes are interpreted by a trained observer. ASWAD, also known as SUBRAC, is designed to take the place of the observer in attack and fighter aircraft.

ASWAD is as good at interpreting underwater sounds as a top sonarman but on better, according to Edward H. Dierker, Douglas president. The system is designed to provide a submarine's position once its general location is known and its ability to give a detection capability to non-aircraft aircraft.

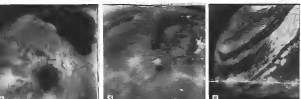
Second, Douglas Aircraft Co. is developing ASWAD, the system would be carried internally in pod form to receive and interpret signals from ASW searchers, displaying position signals and computing location. The system is being developed under a \$1.5 million contract by Douglas Aircraft Co. for the Navy. The system is being developed under a \$1.5 million contract by Douglas Aircraft Co. for the Navy. The system is being developed under a \$1.5 million contract by Douglas Aircraft Co. for the Navy.



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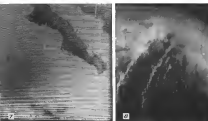


Wide angle views on Tiros I satellite (SW Apr. 24, p. 25) revealed these three photos and relayed them to earth. Narrow angle camera has not been able to record since the orbit launch but relayed direct images. (1) & French West Africa from Cape Horn to St. Louis (2) & Korea & India from Russia's Kamchatka Peninsula to Japan's Hokkaido Island. (3) shows Italy

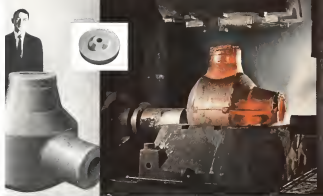


More wide angle shots show (4) Soles, Cell of Siles, hole in clouds over Kato Oka in Libya. Lake Baikal in northern Russia (5) was recorded from 150 mi. altitude and relayed to Kanto Pt., Hawaii. Direct image (6) showed local typhoon flow over Japan to exist. It certainly has. Success of other over Central Pacific, shows great value of even so experimental weather satellite

## Tiros Defines Weather Systems, Land Areas



Potential of photographic satellites for mapping and military reconnaissance is demonstrated by low resolution picture of lower California and Gulf of California (7). High orbit, poorer quality of pictures from early press indicate possibility for considerable improvement, both in weather and other uses. Discovery of cyclone vortices and their distribution from space of a typhoon (8) already have proven usefulness to meteorologists. Typhoon photos, taken by low resolution camera, show storm's eye. High resolution photos, not shown, give detail of cloud structure within storm mass. Storm was located off Australia. Other photos have shown clouds off Hawaii, as well as the Pacific, and ground features that appear to be sand dunes. Low contrast of experimental equipment now makes difficult but improvement is expected as equipment, techniques are refined.



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The exact photograph gives an idea of our range in size and shape while producing the same superior properties. This jet engine turbine wheel, A-280 stainless, weighs about 15 pounds, but is one of today's most demanded

ing application for a precision member.

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2. The movement of metal under

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3. The internal working of the metal breaks up segregated material inherent in the casting of steel and high ductility alloys and yields forgings that consistently meet high ultrasonic standards.

4. The totally enclosed method of forging avoids slag line inclusions, subcutaneous and the buckling effect of the flash grain on transverse fatigue and stress rupture properties.

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## Vickers Foreclosure Threatens Capital

**\$11.9 million in past Viscount payments demanded; airline's turboprop, piston fleet could be seized.**

By L.L. Day

Washington—Capital Airlines, staggered by heavy deficits and a critical cash position (AW Apr. 4, p. 47), received another jolt last week when it was threatened with foreclosure as sales covering its fleet of 96 Vickers Viscount turboprop transports.

In a surprise move—apparently completely unanticipated by Capital officials—Viscount-Armstrong, Ltd., British manufacturer of the Viscount and dual creditor, sent the airline a cable from London on Apr. 12 declaring the sales in default and demanding payment by midnight of Apr. 15 of the \$11.9 million which it and now must due. If payment had not been made by the time, Vickers-Armstrong officials said a second cable would be sent the same demanding that the outstanding balance of \$33.8 million on the sales be paid within three days.

As of late last week, no action had been initiated. However, since the sales are secured by chattel mortgage, failure to make payment could result in seizure of the airline's entire fleet including its Douglas DC-8s and DC-6s and Lockheed 940s as well as the Viscounts.

Viscount-Armstrong officials said they were hopeful that a "round plan" can be worked out to avert such action. Initial steps taken by the manufacturer thus far are in accordance with the terms of the chattel mortgage which provides that, even though the airline may be behind on payments, the sales are not in default until the loans are called. This was accomplished by the cable. Capital is about 12 months behind in its payments.

The action by Viscount-Armstrong followed by four days a Civil Aeronautics Board order turning down Capital's petition for a temporary cash advance (AW Apr. 4, p. 47). Although the Board has not taken a binding vote on the request of the "creditor" protection trust, the decision closes out any hope for a halt for the carrier from its likely financial plight.

In February, Capital announced a refinancing program with U.S. banks and insurance firms designed to bring about \$19.2 million of new cash-in-kind and refinance the British dual creditor. This program has been deemed satisfactorily because declining traffic prevents the airline from meeting current conditions under which the new loans were to be underwritten. As a result, Capital is responsible without any firm plans for raising funds through bank loans through bank loans.

As a consequence, most observers

feel supplies are among the company's largest cashouts.

Centuries of operations could drive the CAA into the picture to determine whether public interest was being harmed by failure to operate. Recommendations for merger or dissolution of the airline's distressed routes could result.

### Revenue Decline

The statement of Capital's present situation is shown by their statistics:

- Revenue passenger miles dropped 15.1% in January, 7.7% in February and 1.9% in March. Transatlantic air carrier revenue passenger miles declined 17% in January, 12% in February but declined only 1% in March.

- Operating performance was the low point of the British carrier, lower than last year in February. Bad weather is attributed as the main cause for this poor showing.

- Load factor has hovered around 57% as compared with a normal 58% to 60% range for the carrier.

- Cash position was \$5.8 million at the end of 1958; dropped to \$3.5 million at the end of February—opening cash to cover about two weeks of operating expenses. To the lowest level reached since 1956 when \$12 million in convertible subordinated debentures were issued to avert working capital.

- Stock holders' equity was \$10.3 million in 1958 and had fallen to \$6.9 million in February. It represented first quarter losses of \$7.4 million as compared, this figure could drop to \$35 million by the end of the month.

### Capital's View

Capital attributes its difficulties to severe operating weather, a series of major accidents, delayed CAA action as the Federal Aviation Administration, the Board's actions in the Toledo Adequacy of Service Case in which Capital was required to increase service there in Toledo, and the short-haul nature of its routes.

Many observers feel that the economic burden of the five-year action, originally totaling close to \$60 million, also play a large role in its not so good show. These notes carried an interest rate of 12% per annum as against the Bank of England interest rate but was not to exceed 12%.

In July, 1958, notes due during four months of the year were deferred and replaced by new notes payable during the last two months of 1958 bear-

ing interest of 21% in excess of the Bank of England interest rate (3%) without any ceiling.

These notes, as well as notes due in December and November of 1958 totaling \$5 million, were not paid during the year.

In 1958, Capital paid \$5.1 million on the debt plus \$2.1 million derived from insurance as deposited assets and the sale of assets during the year. All interest due on the notes was paid through Dec. 31, 1958 according to the airline's annual report.

Lord Knollys, chairman of Vickers, Ltd.—parent company of the Vickers group, in Washington when the cable was received by Capital—said that the airline President David H. Baker had been closed down in a situation that reportedly was considered as an alternative as more assets than that could be obtained by any major airline and other.

### Vickers' Position

Vickers officials, serving upon the advice of the British Embassy here, state that the Civil Aeronautics Board members to explain the name Vickers position was explained this way by Viscount-Armstrong, Chairman, Major-General Sir Charles Douglas, as a statement here.

"Vickers is taking this action with extreme reluctance. [We] recognize the position Capital occupies as a major trunk carrier and public interest in its continued operation and would, at times, be willing to cooperate in a round plan which makes adequate provision for the notes and for the airline of Capital's financial problems."

Capital's problem represents a major challenge to the Civil Aeronautics Board. It stresses both the high costs carrier have undertaken in making the transition from piston-engine aircraft to turbine transports and the depressed load factor that a number of carriers will not likely experience from the real flight competition policy the Board has applied during the past five years in making routes awards.

Board Consideration

Undoubtedly, a number of these issues will be raised when the Board opens hearings on Capital's petition for sale since it has asserted it will perform better than any other airline in the case.

• Dispute between Capital's financial position of the past several years and that of other comparable domestic airlines.

• Basic problem of subsidizing trunk carrier which compete directly with non-subsidized airlines. It also will analyze Capital's record of industry-wide operations.

• Need for development of a complete work with respect to the financing and equipment program of Capital and its relationship of that program to its situation under modern, economical and efficient management.

House Unit Backs MATS Stand; Little Traffic Transfer Foreseen

By Robert H. Cook

Washington—House Armed Services Subcommittee conducted public hearings on Military Air Transport Service credit needs last week on a strong case of support for MATS' proposed medium-range program and with little indication that it will recommend a large-scale transfer of excess military traffic to commercial airlines.

Cost of operating MATS under its present system, as opposed to the higher cash expected from any significant shift of additional business to the airline, has been a guiding factor behind the subcommittee hearings (AW Apr. 11, p. 41). Having already recommended a \$750 million appropriation for MATS modernization in the House Appropriations Committee, the subcommittee also has clearly indicated it expects MATS to justify the use of its new equipment for "hard core" traffic.

Explanations were heard that MATS "hard core" requirements should and will be increased—not decreased, said

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board last week only for a progressive increase in MATS' capacity and cargo traffic to commercial airlines. Passenger traffic, it contends, could be transferred at a faster pace than cargo because of the number of modern jet transports now in use, which a carrier could dispatch at a slower rate, because of the scarcity of commercial cargo capacity.

Noting that these and other reasons would increase the cost to go commercial, Board members were pointed out that the increased revenue which could be realized by the airlines if the recommendations were implemented would encourage them to avoid, as specially designed cargo aircraft, needed to improve the national rail capacity.

However, both the House subcommittee and the Board committee appear to agree on several matters that could be worked out to improve the national rail capacity.

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MATS' need for a five-year duty limit utilization, which has come under attack from every angle without to appear before the subcommittee, leaves a doubt about its future.

Traffic that can be diverted to commercial airlines, industry witnesses have collectively failed to impress the subcommittee that this alternative should be not. Subcommittee leaders have consistently defended this rule on the basis of military figures which show that only 10% of the 5 million tons of movement of civil traffic could be diverted to commercial airlines. Industry witnesses have collectively failed to impress the subcommittee that this alternative should be not. Subcommittee leaders have consistently defended this rule on the basis of military figures which show that only 10% of the 5 million tons of movement of civil traffic could be diverted to commercial airlines.

The Board report also supports the MATS utilization rule and now that, even when civilian aircraft make a high level of origin transfers, "MATS would not be able to handle the business transferred to the degree necessary to maintain a high level of service."

Turning the attention away from the "activity of a group of military specialists to find their own way around" the report says that "the effectiveness of MATS wartime operations must not be jeopardized by an arbitrary cut in training hours. Experience gained during the Vietnam crisis has shown that a high level of training must be maintained at a relatively high rate at it is expected to surge rapidly to a higher rate and testing this higher rate may be a reasonable period of time."

Recommendations by the Board committee on MATS' procurement procedures and the selection of proper

tion for the military contracts, closely follow the thinking of House subcommittee members and point to the danger that a continuation of the anti-bureaucracy will take.

The report also recommends that MATS should in present system of competitive bidding for contracts and would narrow the field of eligible airlines to reinforced carriers meeting these conditions:

- Civil Reserve Air Fleet membership
- Current with fleet orders for modern cargo aircraft
- Sufficient fleet on hand to handle the commitment at the time requirements are presented for the purchase of aircraft
- Good financial, operational records

Each of these points was explored by the House subcommittee, which has criticized MATS' present competitive-bidding system as having contributed toward the bidding of unbalanced anti-aircraft capability. At the same time, the subcommittee has shown definite interest in the possibility of MATS procurement of commercial aircraft under contracts approved by the Civil Aeronautics Board as suggested by the Board report. Such an alternative plan already has been submitted to the Defense Department by Northwest, Pan American, Trans World and Southeastern and Western Airlines.

Major portion of the recommendations

was aimed directly toward elimination of Post 45 airport operation from MATS business. Airline members expected that these operations are capable of expanding a large share of MATS business to low-cost airlines that are not hampered by costs of deep expenses and inequities arising from artificial cost ceiling subject to Civil Aeronautics Board authority.

House subcommittee hearings have shown that a number of Post 45 operators own an aircraft but have successfully bid on contracts for which they would lose less the needed equipment. Violation of Post 45 operations accounts for a large portion of the 94 carriers currently eligible to bid for MATS business, according to airline witnesses. On one contract last year they accounted for 16 of 36 bids.

A point of contention among the airlines has been the House subcommittee's continued reference to the possible need for legislation that would place the Civil Reserve Air Fleet under direct military control in "wartime." The airlines have noted that the fleet and any CRAF contracts should contain provisions from the services that they will operate wherever directed by the military during "general war," limited to a period of "unlimited duration" as determined for contract purposes by the Secretary of Defense.

shortest route of plain sailing "is almost when applied to certain tests."

The supplemental carrier official, represented by the independent Airlines Association, also has met with CAB officials and Sen. Mike Monroney (D-OK) to discuss the impact of the court order.

While further action of the FAA will present additional talks with the Board, questions for the association are they plan to file a legal suit of the court order and a possible review of the Appellate Court decision by the U.S. Supreme Court. Legal maneuvering in the case probably will extend over several months, but the FAA is expected to permit time for hoped-for legislation to amend the Federal Aviation Act.

## Sandys Scores FAA's Test of Decca Mk. 10

London—Conclusions drawn by the U.S. Federal Aviation Agency in its report on operational tests of the Mk. 10 Decca radio navigation system in a Convair C-119 (AW 116, p. 37) cannot be accepted as valid, according to United Kingdom Minister of Aviation Dennis Healey.

Healey, replying to written parliamentary questions, gave the test of a letter sent to the country general of International Civil Aviation Organization, dated May 14 and signed by J. H. Dobbins, U. K. representative on the ICAO council.

The letter alleges there were serious timing factors in the test which in the report, which had not been given due weight either in design of the tests or in the analysis or results.

It was therefore necessary to draw conclusions, the letter adds.

"Serious timing factor" present in trials also alleged in following:

- Large proportion (approximately half) of the route mileage flown was in areas of coverage and accuracy where the Decca Mk. 10 system is not, and has not been shown to be, particularly satisfactory for navigation of all sea traffic control procedures.

• Type of questionnaire used does not permit statistical comparison because there is no communication between operationally significant and insignificant trials.

• Tests were conducted on low power classes in conditions of adverse high background noise level. The reduced power was less than normally provided from other operational classes and appears to have been inadequate for the purpose of the trials.

• Design of the flight log charts was not suitable, unusable for the required purpose of the trials.

# La Guardia's Jet Future Is Uncertain

By Glenn Garrison

New York—Operational future of La Guardia Airport is clouded with uncertainties despite a \$56 million re-habilitation program now under way in the field and the recent decision to provide a second IL5 for instrument Runway 4-22.

It now appears questionable whether one of the current short-circuit bid jobs—Storrs 720, St. Lawrence, Connecticut—will be able to bid to operate permanently at La Guardia. One major obstacle is runway length. Under present plans, Runway 4-22 will still be 5,000 ft. long when the scheduled reconstruction is completed next year, and Runway 1-31 will remain at 5,000 ft.

La Guardia, long one of the world's busiest airports, handled 5,479,344 passengers last year. Six scheduled airlines serve it, among them American, which expects to receive Boeing 737s within a few months and Convair 440s soon after. Regarding the question of instrument or radar navigation at La Guardia, American told AVIATION WEEK that it is not in a position yet to answer. No real performance studies are available at this time, an airline spokesman said.

United Air Lines has ordered the latest F4U Corsairs, with delivery scheduled to begin next spring and the airline reports that Convair's operation at La Guardia looks "unfavorable." Trans World Airlines, seen to get 550, would like to operate there at the airport. "We're in a great fix to take in TWA's plan," TWA said at the time for further procurement of aircraft would consider La Guardia operation.

## 550 Use

Capital Airlines, whose 550 order now is uncertain because of its financial troubles (AW Apr. 8, p. 47), believes the airplane could be operated at La Guardia with minor modifications, but probably would use it at Idlewild (revised because of expected Port of New York Authority and state restrictions). North Atlantic Airlines, expected to order the 550, also would use it at Idlewild and not at La Guardia.

The remaining La Guardia case is Air France, but not yet ordered new short-haul jet equipment. Eastern has operators Airspeed Lockheed Electron power was less than normally provided from other operational classes and appears to have been inadequate for the purpose of the trials.

On the other hand, two have said they would like to operate there at La Guardia. On the other hand, two have said they would like to operate there at La Guardia.

to move Newark Airport with the Convair 440. The last report from TWA, was "unfavorable." Delta Air Lines has formally asked permission and has submitted the required flight profiles for a Port Authority analysis of some other territory.

The Port Authority, whose remarks on the proposals had taken more time on the 550, is evaluating the Delta flight profiles in relation to the noise data. The program should be complete within a few days, but a policy decision will take considerably longer, the agency said.

TWA has not submitted flight profiles for consideration by Runway 22 approach lights and, IL5 have been available in the Port Authority for several years. A problem has been the conflict a standard 1,000 ft. base of approach lights, yet no flight path into the tower, would create with a day closed now and to obtain deep-outside views principally landing off and cool. A standard installation would mean getting U.S. Army Corps of Engineers approval for some place to provide it. Port Authority expects, a substitute for the closed.

Lack of approach lights and instrumentation for Runway 22 has been the subject of considerable criticism and has been included with the study of the American Electric, since the East River in February, 1919, during a lack case instrument approach to the runway. Air Lines Pilot Ann President Clarence N. Sorensen last January contacted letter on the fully instrumented 22 and of the runway. Conducted discharge lights

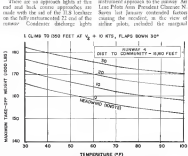
were added to threshold lights of Runway 22 and Runway 1-31 last year and evaluated by an American War pilot (AW Feb. 23, 1970, p. 37). These are not approach lights, however, and much more to identify runway ends.

Minimum for Runway 22 are 100 ft. and 1 ft. which are expected to go down to 100 ft. and one-half mile with installation of an IL5. The present instrumented Runway 4 has the 600 ft., 2-in. lights and will continue to be free of obstructions in the approach path.

## FAA Funds

Funds from Federal Aviation Agency for construction of Runway 22 approach lights and, IL5 have been available in the Port Authority for several years. A problem has been the conflict a standard 1,000 ft. base of approach lights, yet no flight path into the tower, would create with a day closed now and to obtain deep-outside views principally landing off and cool. A standard installation would mean getting U.S. Army Corps of Engineers approval for some place to provide it. Port Authority expects, a substitute for the closed.

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DELTA AIR LINES has formally requested permission from the Port of New York Authority to use Newark Airport with the Convair 440. The last report from TWA, was "unfavorable." Delta Air Lines has formally asked permission and has submitted the required flight profiles, such as the one for Runway 4, for analysis of some characteristics.

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weather and lack of aids for the runway. Civil Aeronautics Board's report on the accident, however, found the probable cause to be attributable to crew error. "The report did mention an inhibiting factor, marginal weather in the approach area and sensory illusion resulting from visual reference . . . to the few lights existing in the approach area."

The Port Authority and FAA last month jointly announced a decision to go ahead with a second ILS for Runway 4-22, installing the standard 5,000 ft of lights and then the outer landing aids.

### Channel Substrate

According to the Port Authority, the timing of this decision depended on completion of an FAA-Port Authority study of possible alternatives to providing a substrate for the channel. Three alternatives included having a 900 ft gap in the line of approach lights due to the channel, or depressing the entire system to 1,000 ft or so. The study ruled out these possibilities, the Port Authority said, and then it was decided to go ahead with the channel substrate method.

Assessment of the ILS plan was made under the aegis of FAA Administrator E. R. Quesada and Port Authority Chairman S. Sloan Colt.

Some FAA officials, however, told Aviation Week that the facts are the same as they have been for several years—i.e., that the FAA would never have approved anything but the standard configuration of 1,000 inches feet of approach lights. No studies were necessary, FAA sources said, to back the need for using the channel except for two surveys to determine location and the like. FAA, it was said, has been working for the Port Authority to clear the project.

### Pilot Personnel Cited

Some sources have suggested that the Port Authority's decision to go ahead with the expensive project was triggered by pilot pressure, with the Electric Union coming as a catalyst.

It would be unfair to single out La Guardia as the only target of pilot criticism. Surely, including before the Sea Airs Association Subcommittee, looked out at approach facilities "at a large number of our airline airports" (AW Feb 8, p. 168). Last month ALPA counsel is the Dallas-Fort Worth area severely criticized approach and landing facilities at Love Field, Dallas (AW Mar 18, p. 43).

La Guardia Airport actually is unlikely to get its second ILS for three or four years from now. That amount of time, in the Port Authority's estimate, will be required to complete plans, get them approved by New York

City and the Corps of Engineers, and do the actual work. The cluster for 1,000 ft of lights, however, will be installed by approximately November of this year, period during which Runway 4-22 will be shut down in the rehabilitation program. FAA will then install the lights.

No ILS equipment will be installed until the fall 1,000 ft of lights is in place.

The Port Authority has three alternatives to work with in substituting for the ship channel.

It could build a new channel, possibly by cutting straight through Babels Island to provide access to the area southeast of the airport; deepen a shallow channel already in existence on the east side of the island, where rock bottom would be nearly to the east, or provide some other means of moving the east end, possibly pipelines or conveyors.

The present channel, which brings ships around the east side of the island, has a waterway 200 ft wide and 400 ft deep in the area where the approach lights would intrude.

No estimate of the cost of providing a channel substrate, plus pilot training for FAA to install the landing aids on, is available from the Port Authority. That agency initially will bear the expense, but will pass it along to the airlines, according to its formula for landing fees and other charges. Unlike the airport rehabilitation project, which required airline approval and was under

negotiation for a long time, the channel project requires only Port Authority high-level approval.

The Port Authority explained it to Aviation Week that way in adhering to the channel project costs. "These expenditures which a prudent airport operator would make for public safety benefits are reflected in the fees payable by the users. In such cases, prior airline consultation, while desirable, is not required."

Some airlines told Aviation Week that the decision was news to them and required further study before comment.

### Additional Improvement

Another proposed improvement to La Guardia Airport—and one that seemed to meet industry sources an apparent close-to-extension of Runway 4-22 by 1,000 ft, or to wait the buy to provide at least 6,000 ft of instrument runway. Various estimates placed the cost of such an extension at from \$5 to \$80 million.

However, the Port Authority and airlines have failed to agree on how the project would be paid for. Airlines reportedly split among themselves on whether the extension was worth the expense. Some thought the Port Authority's formula for recouping the investment was unfair to the airlines. In any case, some sources believe it is a false economy to spend \$16 million on the rehabilitation, plus whatever the second ILS will cost, and to withhold the relatively small additional expense of the runway extension.

## 707s Flying Los Angeles-Paris

Los Angeles-Air France, French national airline, has begun the first jet service between Paris and Los Angeles with Boeing 707s, bringing the airline's total undesignated routes to a figure of 201,500 mi.

Two flights per week in each direction now, as scheduled between the two cities and plus one to four flights per week each way next year.

Air France now has 17 of the Boeing 747-200s in its order, with 11 scheduled for delivery by September. Probability is that the airline will order more of the same to augment its international service, which provides for 98 seats in the economy class cabin and 32 seats in the first-class compartment, plus a "premium" seat for out-of-seat passengers.

Intense competition is at Montreal for refueling Los Angeles-Paris passengers will be offered cheaper privileges for a successive flight. The airline also will be permitted to stop passengers en route at Montreal for Paris. On the Paris-Los Angeles run, stopovers will be allowed at Montreal, where the air-

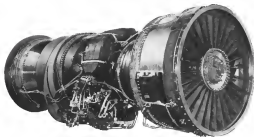
line also will be allowed to disembark passengers. No passengers traveling only between Los Angeles and Montreal will be permitted.

At Los Angeles, Trans World Airlines will perform tomorrow's maintenance for Air France. In Montreal, maintenance probably will be handled by the local firm, the Societe Aerienne Can. of Canada, Ltd.

Estimate is that for Air France to perform its own maintenance at these locations on an annual schedule of about \$20,000 to \$100,000 would be required for equipment.

In addition to its U.S.-France jet service from Los Angeles, Chicago and New York, and the only jet service from Paris to Anchorage and Tokyo, Air France operates four weekly jets from Paris to 20 European cities in Europe, Africa and the Middle East. Air France will soon introduce Concorde service from Paris to Copenhagen, Stockholm, Warsaw and Moscow. In between, the airline will be serving the Concorde 42 cities on its jet-jet routes.

## GOES LONG GOES STRONG GOES ECONOMICALLY



PRATT & WHITNEY AIRCRAFT'S NEW JT3D TURBOFAN ENGINE INNERITS THE EXTRAORDINARY RELIABILITY OF ITS PREDECESSOR, THE J-57 TURBOJET, PROVEN IN 6 MILLION HOURS OF FLIGHT. AT THE SAME TIME, IT SETS A NEW HIGH IN THRUST AND A NEW LOW IN FUEL CONSUMPTION.

The new JT3D turbofan has the same basic design as the JT3 (J-57) and JT4 (J-75) turbojets powering 9 out of 10 Boeing 707 and Douglas DC-8 jetliners and many military jet aircraft. Functionally, the difference is the addition of the fan and provision for a secondary flow of air. The reliability has not changed because the basic engine design has not changed. But the addition of the fan has effectively increased the thrust and decreased fuel consumption for greater operating efficiency. It is simply a case of the most reliable jet engine in

its class getting even better.

By comparison with its predecessor, Pratt & Whitney Aircraft's new JT3D turbofan raises take-off thrust by 42%, boosts climb thrust by 23%, and pushes maximum cruise thrust up 13%—all this while cutting down cruise TSFC by 13%.

The JT3D, flying since July, 1969, has met or exceeded all performance guarantees and estimates and has successfully completed its 50-hour military test. Military prototype deliveries have been made. Military production deliveries start in June, commercial in July.

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## Nuclear-Powered Cargo Planes Proposed

New York—Nuclear-powered cargo aircraft can pay their own way in a cost benefit comparison, if the period is large enough and the market attractive, according to J. T. Brady, an engineer for Convair Division of General Dynamics in Cary.

Brady and other speakers at the recent Society of Automotive Engineers' National Aerospace Meeting here—in what appeared to be an attempt to stimulate the aircraft nuclear propulsion program—discussed the technical and commercial feasibility of nuclear aircraft and generally agreed that further studies and investigations in this area were warranted. (See page 106 for other SAE National Aerospace Meeting reports.)

### Interesting Ideas

Other engineers at the meeting found some of the ideas offered by the speakers interesting but felt that it was still too early to attach much significance to the extremely sparse data now available on the subject of nuclear-powered aircraft.

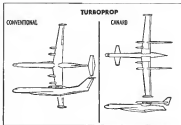
Brady believes that data developed by U. S. Navy as its studies of nuclear-powered military logistic aircraft are relevant and applicable to commercial cargo planes, since the former ones have speed, low radiation-type aircraft. It is then Navy data, modified for commercial application, that Brady uses as the basis for his present study.

### Scalable Design

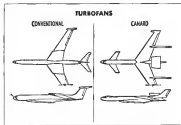
The nuclear-powered cargo aircraft proposed by Brady would be about 160 ft. long, have a 300-ft. wingspan and would weigh about 1 million lb. including approximately 400,000 lb. of payload. To eliminate potential reentry, radiation and hazards, it would be designed as a scalable, low-pressure aircraft. Cargo would be contained in large payload capability as well as an essential requirement in it as an aircraft, at least nuclear-powered aircraft will have to carry heavy engines and shielding. Fuel consumption will be negligible so weight will remain relatively constant. Thus, to ensure an economic payload, payload will have to be large (for a feasible payload-to-gross-weight ratio and distances will have to be great).

Cost-per-ton-mile remains fixed for the nuclear-powered cargo aircraft: reduction of cargo and fuel costs proportionately there is eight cents per ton-mile. Brady figures that 1,500 ton-miles is the crossover point in range at which the nuclear-powered cargo plane begins to look more attractive than the conventionally fueled aircraft.

Among the assumptions on which



NUCLEAR turboprop airplanes would cover 280,000 ft. per hour at 500 ft. cruise.



NUCLEAR turbofan airplanes would cover 280,000 ft. per hour at 500 ft. cruise.

Brady bases his estimates are the following:

- Aircraft life will be 10 years, aircraft utilization 4,350 hr. per year.
- Aircraft depreciation will range from \$13.55¢/lb. of aircraft weight (engine, weight less engines, propellers, motor and electronics).
- Engine depreciation, exclusive of nuclear fuel costs, will be between \$13.55¢/lb.
- Fuel costs are figured at 50¢ and 75¢ of computed direct costs, and no development costs are assumed.
- Aircraft is not shielded (that is, shielding is omitted outside cargo), and the crew radiation dose is such as to allow 1,500 flight hours per year.

• Cruise altitude is 25,000 ft. and aircraft block speed is 550 kt.

For propulsion, Brady believes that the nuclear-powered turboprop and the nuclear-powered turbofan will both serve equally well. Even an engineless straightjet. In the speed range considered, under Mach 1, the turboprop, he says, does not compete. For the same payload weight, the turboprop aircraft will weigh 500,000 lb. more than the turbofan aircraft in gross weight but its cruise speed will be approximately 500 kt. against 550 kt. for the turbofan and so will be able to make more trips in the same time.

But perhaps the most important factor in the actual choice of the power-



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plant, in Brady points out, will be the location of the refinery in this field. The nuclear aircraft powerplant which the military desires to build will be of the type of powerplant that will be used in a conventional aircraft. It won't necessarily be used as it is, but at least only minor modifications are to be selected.

#### Supporting Conclusions

Additional support for many of Brady's conclusions was provided at the meeting by Douglas Aircraft engineers D. F. Lohr and W. C. Schell. Using data from a Douglas study in the choice of an engine for a nuclear-powered, multi-purpose aircraft issued primarily for logistic reasons, Lohr and Schell reached the following conclusions:

- Maximum productivity (payload times speed divided by takeoff gross weight) (rather payload) is obtained with the nuclear-powered turboprop aircraft flying at Mach 0.6.
- Both turboprop and turbine engines develop much more thrust per pound of engine weight during takeoff than the turbojet and so would be subject to fewer runway restrictions.
- Down rate is an aircraft with a shielded reactor would allow crew reduction of 10 to 15 per cent.
- On a subjective scale on which the productivity of the nuclear turboprop is rated at 1.0, the turboprop and the turbojet are rated respectively at approximately .95 and .85 and both reach their peak productivity at Mach 0.6.
- On a productivity-per-engine-at (of active power) basis, the turboprop has approximately twice the maximum productivity of the turbojet and four times the maximum productivity of the turbojet aircraft.
- Increases in cruise altitude for nuclear aircraft result in serious decreases in productivity—as much as 25%, for example, when the altitude is increased from 25,000 ft to 35,000 ft. For a multi-purpose nuclear aircraft, Lohr and Schell noted, altitudes of 20,000 ft to 25,000 ft are an acceptable compromise between maximum productivity and the ability to stay above most of the weather for flight safety.

Brady said, and what came a

an operational altitude of 10,000 ft. Cruise requirements would run from 30 to 50 kt and open flight cycle turboprop engines would be used for power conversion. Assuming an overall efficiency of 15% for the conversion of reactor heat to shaft horsepower, turbojet nuclear power of only 5 to 7 megawatts would be sufficient. Besides this, which would be not shielded, also would provide a comparative weight saving in the required shielding.

Reactions to these nuclear propulsion proposals were mixed. Some engineers favored them, others felt that the item was still too far off the future at this time to even merit serious consideration. As one scientist from General Electric's aircraft nuclear propulsion project explained, the primary problem right now is just getting a nuclear engine into an airplane and making it work, and it may take another five years just to do this. After that, he added the system must still be advanced to the point where it might be made feasible for commercial application.

Right now, there is no real demand for a commercial nuclear-powered aircraft, either for cargo or personal transport, a Lockheed engineer pointed out.

Brady said, and what came a

currently under way here is mostly as engine development.

Engaged rather briefly at one time in the development of a nuclear aircraft, Lockheed has not been in effect in the area. At this point, said the Lockheed spokesman, engine development is the governing factor in the overall nuclear aircraft program. So in some months after the engine becomes available, it can be airborne (in testing) and the problem as airplane development was given about 36 months before. Taking other factors into account, it won't fall that five years from now would actually represent an optimistic maximum time for getting a prototype nuclear aircraft into the air.

#### Commercial Applications

From the point, as far as commercial applications are concerned, it will be another year before any meaningful data is developed. It will be even longer before a fix on maintenance requirements is obtained or sufficient data is available for establishing insurance rates.

The Lockheed spokesman said it would be interesting to find out how technicians would handle, say, a situation in which the aircraft—already in the runway and with reactor running—developed a flat tire.

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## AIRLINE OBSERVER

► **Transline** elements starts begins to show stress slight strength last week following a long period of heavy lifting which set new 1980 lows for a majority of airline listings. During the early part of last week, several transline showed strong gains in the face of a declining market.

► **Japan Air Lines** is considering the purchase of Sud Caravelle turboprop transports and a cargo version of the Douglas DC-8.

► **Winds** for Federal Aviation Agency to propose a rating that would limit to 8 hr. the flight deck duty for two-engine crew on piston engine aircraft of U.S. international routes. Under the proposed ruling, flight-pilot crews could be scheduled for a maximum of 18 hr. duty time including 12 hr. sleep. Purpose of the ruling is to hold actual flight time duty to a maximum of 5 hr. per pilot rather than the 12 hr. period now authorized.

► **United Air Lines** will install a proximity warning indicator adapter for airborne weather radar on one of its regular fleet aircraft in the near future to obtain operational experience with the device. Recent tests by United indicate that the small adapter developed by Radio Corp. of America may enable airborne weather radar to detect other aircraft in the forward region and automatically alert the pilot (AWA, Apr. 11, p. 40). Adapter is expected to sell for about \$5,000 in quantities.

► **Russia** is improving its frequently-positioned weather reporting system for foreign air carriers operating into the USSR. New teleprinter service to exchange meteorological and aerological data has been installed between Moscow and Delhi as a direct aid to both Air India International and Aeroflot, state-owned Russian airline.

► **Hawaiian Airlines** will undertake a financing program involving up to \$40 million if it is awarded the transpacific routes it has requested from the Civil Aeronautics Board. Equity financing ceiling for a \$9.5 million to \$13.5 million stock issue will be included in the program.

► **Eastern Air Lines** has equipped its Douglas DC-8B turboprop transports with "strong shockrooms" located in forward cargo compartments to bulk-stop terminal shockrooms for en route maintenance. Total of 240 parts valued at \$118,000—including generators, pumps, washers and lamps for passenger cabin—are stored in the shockrooms measuring 4 ft deep, 7 ft wide and 5 ft high.

► **Federal Aviation Agency** has contracted with Raytheon Co. for the purchase of eight ARSR-2 long-range radar at a cost of \$6.9 million. ARSR-2s will be equipped with an improved high-gain antenna system, improved warning target indicator system and a noise filtered receiving system for the radar echo signal than that incorporated in the ARSR-1 radar now in operation. Transmitter power is approximately eight times that of the ARSR-1. Program is now under way to increase power of the ARSR-2s to assure power of ARSR-2s.

► **Airline traffic**, which fell off sharply in many major markets during March, appears to have made a strong recovery during the opening weeks of April. Although the late upward swing is generally attributed to a surge of Easter holiday traffic, many observers feel that last year's rising traffic trend has been reduced now that the threat of bad weather is diminishing. Poor showing in March has been bad to weather and the impact of accidents.

► **Five additional megachannels** of radio frequencies have been allocated to the Federal Aviation Agency for air traffic control communications. New frequencies, from 120.825 to 129.825 mc. and 130.825 to 135.0 mc., will be effective July 1 and will add 100 channels to the air traffic control system. Additional megachannels enabled FAA to develop a frequency deployment plan which will achieve cooperation and interference on very high radio frequencies.

## SHORTLINES

► **Allegany Airlines** transported a new service into the New England area last week with flights from Washington to Baltimore, Bridgeport and Boston on a three round-trip per day basis, with one of the three stopping at New Haven. The local service comes last week also began three daily round trips between Pittsburgh, Philadelphia, Providence and Boston. Convair 440 aircraft are being used in all flights until Allegany's fleet of Convair 540 turboprop aircraft are ready for service.

► **Bonanza Air Lines** reports that it flew about 145,000 passengers with its fleet of six Fieschold F-27 turboprop transports during their year of operation. Bonanza says the F-27s now carry approximately 55% of the passengers flown over its routes.

► **Irish International Airlines** flew 22,000 passengers over its transatlantic routes during the fiscal year ending Mar. 31, an increase of about 50% of the total for the first 11 months of the previous fiscal year. The Irish airline also reports that it carried over 195,000 passengers on its European routes in Fokker F27 Friendship turboprop aircraft during the year. Officials hope to place the airline's three Boeing 707-361 (701) turboprop transports to service on transatlantic routes before Christmas.

► **Pen American World Airways** has received Air Force and Civil Aeronautics Board permission to use Ladd AFB, Alaska, in the operation of its Boeing 707-361 turboprop service between Seattle and Fairbanks.

► **United Air Lines** has signed contracts with all 16 major league baseball clubs to travel aboard chartered United aircraft. Eighty of the teams will use United service exclusively. The Milwaukee Braves, Cincinnati Reds and Chicago White Sox have made arrangements to fly to the West Coast in chartered jet-class sections of United's Douglas DC-8 turboprop aircraft on regularly scheduled flights. Teams will travel 277,692 mi.—32,487,144 revenue passenger mi.—on 444 chartered flights.

► **Western Air Lines, Sabena Belgica** World Airlines and Boeing Airplane Co. have ordered Wayne King Corp. flight data recorders, bringing to nine the number of firms that have ordered the system. The recorders report and preserve operational flight information for study and engineering analyses and are designed to provide early warning of possible malfunctions. Test orders to date are worth \$1.7 million.

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WING CONES are attached to four nozzle openings. Wing cone assembly is placed, slats and harness attached, cone is ready for testing.

## Hercules Increases Motor Test Facilities for Minuteman

By Michael Yaffe

Napa, Utah—Hercules Powder Co. has strengthened its bid to produce the third stage motor of the Minuteman intercontinental ballistic missile with completion last week of two additional 1-million-lb.-thrust static test stands at its new Chemical Propulsion Division facility here.

At present, Hercules and Aerojet-General both hold development contracts on the Minuteman third stage motor and Air Force is expected to decide on the production supplier by late summer or early fall. Meanwhile, the new test stands, able to accommodate large solid propellant rocket engines in both horizontal and vertical thrusts, complete the current construction program at Hercules' newly owned solid propellant complex here and will place the corporation just in its drive for major roles in future missile programs.

### Designed for R&D

Set up in 1955 as one of the company's old Barbas (Utah) dynamite line, the solid propellant works is designed primarily for research and development of large rocket engines. Here the emphasis comes not research, development, production and evaluation of its advanced double-base propellants. Now, it has outside contracts and financed several static motor tests, from Hercules' Young Development Division in N. Y. are evaluated, sometimes along with new propellant formulations, in the static firing of different Minuteman third stage motor test configurations.

Under contracts and propellant rocket engine work in Hercules' ARL-20, and in the Pioneer V and other



PATOFF for all the development work, production and quality control effort comes in the static thrust stand where solid propellant rocket motors are fired.



SOLVENT MIX is pressure-fed through lines into heat grain powder in cone. Gases and motor are then checked with 25 mm. barometer.



HERCULES TECHNICIANS carefully examine motor part in test evaluation field and check motor part and casing alignment.

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Figure 1. The effect of the concentration of the polymer on the gelation time.

1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 26

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space, guides, also an elastic feed.

At this point the company is unable to say much about actual Minuteman third stage research and development work under way here. It is known that the company has successfully fired full scale, third stage test motors and that Hercules scientists and engineers are still evaluating nozzles and combustion materials.

As one of the first two Minuteman stages (AW Apr. 4, p. 23), the first nozzles on the final configuration of the third stage are expected to be movable and possibly will be made of plastic with metal inserts. The need for better core insulation, according to one per-

sonnel expert is also, in the higher altitudes, and hence, higher combustion temperature of the advanced double base propellants and not to the use of reinforced plastic core.

Hercules has successfully loaded its propellants in the Minuteman core plus core and does not anticipate any trouble in storage of its new double base propellant. Problems of thrust termination and core configuration are believed to have been satisfactorily solved.

As far as propellant performance goes, Hercules officials feel that they already have come close to the limits achievable with high energy liquid and

solid rocketing their work on the development of better additives which they believe hold greater promise at this point for improving overall performance.

Although research and development is the primary activity here at the time, the Magnus complex was designed for the ultimate production of large solid propellant motor grains. In all, Hercules plant here employs 695 persons and occupies 2,506 acres. Of the total acreage, approximately 314 are allocated to administration and document manufacturing, 49 to housing and 96 to solid propellant facilities. From the measuring 5,000 sq. ft., Hercules has tentatively allocated 454 to future solid propellant manufacturing facilities and 1,120 to storage.

#### High Energy Propellants

Principal production activity here at present is the manufacturing of high energy, cast double base rocket propellants.

Most of a hybrid than a true double base (AW June 13, 1955, p. 47), these advanced propellants are sometimes termed composite modified double base propellants. They are, in effect, composite propellants with high energy, double base bodies that incorporate gas throats a specific impulse 7.5 sec above that of a conventional composite propellant.

The new double base propellants are somewhat non-petroleum based, that is, their burning rate and performance are affected by ambient air (temp, humidity) but this also is believed to be the case with some of the advanced, composite rocket propellants. For missiles such as the Minuteman and Polaris, which will be fired from protected or environment-controlled launch areas that is not considered a significant problem.

Principal ingredients of Hercules' new composite modified double base solid rocket propellants are base-grain powder, nitrocellulose, isocyanate and bis-isocyanate. The base-grain powder consists of two separate bases, nitrocellulose and nitrophenyl, stabilized such as 2-nitrophenylamine and diethylenetriamine, graphite, powdered metal (possibly aluminum) burning rate modifiers, and an antioxidant preservative under.

It is made at Hercules' Roswell, N. J., plant and at the company-operated Redford Arsenal and shipped to Utah. At present, the manufacturing, which comprises about three to four million lbs. does domestic base, is the only thing made at the Utah plant. Scientists in the future, Hercules may make the casing and other solid propellant parts.

Basic steps in the cast double-base process, now in operation here, by

which Hercules takes propellant can already and lightweight and burns them into finished solid propellant rocket motor are as follows:

• **Case preparation.** After the rocket case arrives at the Magnus plant, they are inspected and cleaned. Then, while sitting around their horizontal case, they are sprayed with an epoxy resin and coated internally with a nitrocellulose or cellulose acetate bonding agent.

• **Mold assembly.** Mold units—consisting of cores, base plates, top plates, bonding harness, mold loading fixtures and curing assemblies—are bolted in and around the case. To ensure that the final propellant will be within specified web tolerances, technicians carefully inspect the final assembly.

• **Loading.** In one method—termed air loading—the base-grain powder is blown into the case through a series of tubes or concentric rings. Either before it is loaded or after, the powder is subjected to vacuum treatment and to create a partial vacuum in the internal area of the base-grain which will increase the rate of grain after curing.

• **Sched preparation and curing.** With the case being prepared and loaded with base-grain powder in action (in plasticizer) and 2-nitrophenylamine (in stabilizer), an initial curing heat in an oven is applied. The curing is weighed into a clean steel desiccator and transferred to the nitrophenyl atmosphere where a measured amount of nitrophenyl is added. The react is moved to the solvent evaporation building, removed, and put under vacuum to remove all traces of water.

• **Casting.** In the operating building the solid is transferred through a hose and under pressure to the case with the base-grain powder. While casting is completed, as indicated by a certain flow of solid out of an opening in the opposite end of the case—the motor is transferred to a curing bin.

• **Curing.** Temperature in the curing building are generally maintained some where between 70°F and 140°F. The water is kept low, and the propellant now has a liquid solid within into a completely solid grain. This cure takes from one to 10 days.

• **Disassembly and machining.** From the curing bin, the motor travels to the solid rocket machining building where the mold set is removed and the motor is placed in its final configuration.

• **Inspection.** The motor is given a final control check before being shipped. This may mean undergoing ultrasonic scanning and X-ray to detect foreign matter and possible faults in the grain. In its non-destructive test building, Roswell has a 15-million-electron-volt betatron for inspecting large rockets and

before the bird takes off

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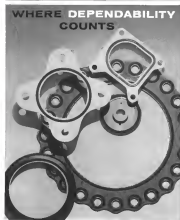
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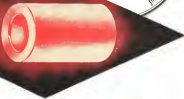


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**Titan ICBM Appears to Pass Moan**

Air Force-Martin Titan intercontinental ballistic missile appears to be passing the moan in the photo made from a tracking camera during a recent firing. An observer pointed upward following the missile as it caught the moan in the background.

**J69's Afterburner Burns Pyrophoric Fuel**

A 100-lb.-oil X-ray window, for testing small rockets and components. Small test rockets made from this same metal but as the large engines also may be used to the engine and sample machining by using a hole, sample specimens are cut off and prepared for further analysis and laboratory testing of their chemical and physical properties.

• Rocket assembly: If the motor comes through its final inspection satisfactorily, it then is moved to the rocket assembly building. Here, nozzles, igniters, tank and zero mechanisms, and all other required hardware are added. The unit is checked for full moment and center of gravity. Then it is either outgassed and shipped to the user or transferred to a Hercules test bay where it is stored.

Hercules already has fired five solid state Minuteman third stage test engines at Major. Company was ordered it is "glued with the results."

Pyrophoric-fueled afterburner developed by General Motors' J69 jet engine used in the air force's F-105 fighter plane, is designed to give the Mach 3 jet engine superheated high-altitude capability.

Afterburner system, developed by General Motors' Rocket and Space Group, has proved engine qualification calendar: testing and awaits a contract from the military to go into production.

Universal feature of the afterburner is its short length. Designed to replace the tail cone now used on the J69, the short afterburner requires no alteration in exhaust design. To keep the afterburner short and simple, Continental engineers designed the unit in one piece, prepackaged back into an air filter housing (AW) Mar. 25 p. 85).

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## THE ASTROTUG

**Tagteam for Space:** Spaceborne satellite laboratories and platform for further exploration into space are as accepted concepts based on established engineering techniques. Components would be built in individual units into space, on precalculated orbits, and then assembled. To solve the major problems of how men are to live and work in space during the assembly process, Lockheed has prepared a detailed engineering design of an *astro tug*—a manned vehicle housing a crew of two or three. Missile-launched, the *astro tug* will be capable of supporting its crew for a number of days in an environment of suitable atmosphere, artificial gravity, and with provisions for exercise, sanitation, bathing facilities, medical care, illumination and adequate food and water.

The Lockheed *astro tug* is a completely independent working vehicle. Personnel need not leave it in space vans in order to work on the project of assembling the space station components. As shown in the diagram, the *tug* consists of two double-walled pressure vessels approximately 20 feet long overall and 9 feet in inside diameter. Servicing rocket engines are arranged for maneuvering. On the forward end, extending out are four mechanical manipulator arms with interchangeable "hands" for such specialized functions as gripping, welding, hammering, cutting, running screws, etc. "Horch," a six-beamed by remote control from inside. Viewing ports provide uninterrupted observation. Radar antennas, searchlights, and other equipment necessary to the *tug's* work are mounted externally. Main controls and instruments including radar, radio, infrared, computers and navigation consoles are duplicated in each of the two major compartments as a safety measure.

Men working in single units aloft in space suits would have little applicable force and could work for very limited periods of time. With the Lockheed *astro tug*, personnel could carry on the work in relative safety and comfort with maximum efficiency. A special rescue vehicle, separate from the *astro tug*, has been conceived for ferrying to and from earth. *Tugs* themselves would remain floating in orbit indefinitely, being repositioned and refueled as fresh crews arrive in relief.

Space vehicle development is typical of Lockheed Missiles and Space Division's broad diversification. The Division possesses complete capability in more than 40 areas of science and technology—from concept to operation. Its programs provide a fascinating challenge to creative engineers and scientists. They include: orbital mechanics, computer research and development, electrodynamic wave propagation and radiation, electronics, the flight sciences, human engineering, magnetohydrodynamics, man in space, materials and processes, applied mathematics, oceanography, operations research and analysis, sonic, nuclear and plasma propulsion and exotic fuels, optics, space communications, space medicine, space navigation, and space physics.

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## Multi-Mission B-58 Proposal Detailed

Washington—Usually rapid improvement in the operational state-of-the-art during the past few years is adding the Air Force in its efforts to obtain more versatile aircraft.

The unexpected part is aeronautical knowledge over the last half of the 1950s, which was dominated in detail by the National Aeronautics and Space Administration in its second semi-annual report to Congress (AWM May 28, p. 29), prompted USAF Chief of Staff Gen. Thomas D. White to discuss the possibility of developing an acceptable multi-mission aircraft for two or more of his three major commands—strategic, tactical and air defense.

## Three B-58 Versions

Specific examples of the use are manufacturers but made of new technological developments to meet the multi-mission goal is the Convair B-58. Three new versions of the B-58 have been proposed by the Air Force, each of them tailored for the mission of one of the major commands.

Physically, there is little difference between them save design proposals and the B-58A now being with the Strategic Air Command, but all of them are designed for greater range than the B-58A and to fly consistently above Mach 2, a speed which the subsonic cruise B-58A can fly for only a short time.

Proposals for all supersonic versions of the B-58 include the B-58C as an advanced SAC bomber, the B-58D as a long-range interceptor and a substitute for the now-cancelled North American Avon, Mach 3 F-105 for the Air Defense Command and the B-58E as a Tactical Air Command bomber.

Substantial cost savings could be realized if all three commands operated the same basic aircraft, cutting down the number of aircraft types maintained by the Air Force. Production costs would be decreased through large numbers of aircraft produced, and spare parts would come down through reduction of the numbers of parts in the aircraft.

Flight test data from the B-58A and development programs in the last three years or so have shown that a significant performance improvement can be obtained simply through the use of Pratt & Whitney J75 engines and improvement and redesign of components the first lot of the wing closed.

The first General Electric J79 engines on the B-58A each supply about 10,000 lb. thrust with afterburner, the J75 powerplant produces approximately 10,000 lb. thrust with afterburner.

The all-purpose B-58A seems also includes a Mach 2.4, 32-passenger transport using the B-58C wing and vertical tail with a large fuselage and

horizontal tail (see picture on p. 67).

Convair believes that this transport could make its first flight two and one-half years after detailed design was begun and that it could be certified less than a year and a half after that. Gross weight of this aircraft would be 790,000 lb., at slightly heavier than the B-58A.

It would have a range of 2,125 mi. at 15,000 ft. with fuel reserve. It could operate from 5,000-ft. runways and has an estimated direct operating cost of 2.2 cents per seat mile.

## Cruise Speed

Cruise speed at Mach 2.4 was determined to be the highest that could be maintained in continuous service with the construction materials of the B-58 wing. Convair tests indicate cruise speed 1,000 ft. on the B-58 structure at elevated temperatures plus state-of-the-art materials from all sources were the basis for setting the Mach 2.4 limit.

Although the B-58 uses a large amount of steel honeycomb, it is still considered to be an aluminum aircraft so far as airframe bending. Convair sales efforts for this aircraft to U.S. military and civil aviation authorities, who are convinced of an impending national prestige and economic crisis in the area, have stressed that the presence of certification within the



TRANSPORT VERSION of the B-58 has been proposed to military services and the airlines. In Convair's aircraft would come at Mach 2.4 and carry 32 passengers.

next four years is about the best hope the U.S. could have for becoming the first nation to operate supersonic transport.

Searches are generally expected to have been working on a Mach 2 transport for the past two years.

Cost of the Convair transport is estimated at \$10.515 million, depending upon the quantity produced.

## Flight Efficiency

Improved flight efficiency of the all-purpose B-58 seems more prominent than the fact that these aircraft are designed strictly for flight around the Mach 2.4 regime and no compromises have been made in an effort to provide good subsonic cruise performance at Mach 0.8 as was done in the B-58A.

The B-58A configuration was first study in the 1940s when engine and airframe technologies were being striven to provide high subsonic cruise over long

distances with a half as long as of Mach 2 plus dash from the Soviet carb-narrowing line to carrier targets.

To meet this requirement at the time, it was necessary to utilize a new engine design substantially with the B-58 airframe, rather than make it with an engine that was far enough along in its development cycle to be a known quantity.

This engine, the General Electric J79, set its design specifications and was able to operate efficiently at both subsonic and supersonic speeds but its performance, like that of the B-58A airframe, was necessarily compromised and could not be the optimum at either speed range.

Converting the basic B-58 aircraft to the supersonic performance means through engine and wing changes was accomplished as follows:

• **Engine.** The J79 is one of the first turbojet engines in the U.S. designed for continuous supersonic operation.

When it has a low compressor compression ratio is constant to the J79 which needed a compressor with high pressure ratio compressor for good fuel consumption at Mach 0.9.

## Specific Fuel Consumption

Specific fuel consumption of the J79 without afterburner at Mach 2 is in the neighborhood of 1.15 lb. of fuel per lb. of thrust per hour. This figure for the J79 which required afterburner operation to push the B-58 at Mach 2 is around 5.5 lb. of fuel per lb. of thrust at that speed. This major improvement in specific fuel consumption is largely attributable for the long range of the improved B-58 aircraft at supersonic cruise.

Final component figures for the J79 are fairly solid at this point save the complete engine has been under test for about two years.

• **Wing.** Leading edge of the B-58A wing has a large concave chamber which starts at the wing root and becomes progressively more pronounced toward the wing tip. The pressure, benefit of curved chamber is in reducing drag at high subsonic Mach numbers.

On the all-purpose B-58 models, curved chamber has been abandoned and a sharp straight leading edge designed for approximately Mach 2.4 has been substituted. Change resulted in about a 50% increase in supersonic lift-drag ratio from a value of about three to four for the B-58A to about six with the new model.

## Pod Engine Mountings

Referring simply structural changes in the original B-58 to achieve the all-purpose performance can be added and largely to its pod engine mountings that can easily accept larger



COHAFR B-58C, above, an improved version of the B-58A strategic bomber, will cruise consistently above Mach 2. The B-58A cruises around Mach 0.9 with short-time dash capability above Mach 2. Four Pratt & Whitney J75 engines with plug nozzles power the B-58C.



LONG-RANGE INTERCEPTOR, B-58D (top) has been proposed for Air Defense Command. This aircraft and the B-58E (bottom) are powered by two Pratt & Whitney J75 engines with afterburners and they cruise consistently above Mach 2.

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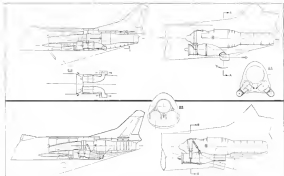
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**INSTALLATION DRAWINGS** for compact propellant system based on Fiat G-91 lightweight strike fighter show power transfer techniques with several engine spring mechanisms of thrust from full aft to full forward (top). Second arrangement, which requires engine supporting itself performance such, mounts the engine in a swing through a 35-deg. angle downward from thrust line (bottom).

## Short-Takeoff Version of G-91 Studied

By David A. Anderson

Torino, Italy—Fiat G-91 is the design chosen for a design study of a compact propellant system applied to the airframe of the G-91 lightweight strike fighter. Study is currently being conducted by the Italian Weapons Development Agency.

Major purpose of the compacted system, which uses a pair of auxiliary turbojets of very high thrust-weight ratio, is to improve the short takeoff and landing characteristics of the G-91. Typical calculations using the G-91 as the base show that island and landing distances could be reduced to approximately 500 ft.

Full patent drawings for the compacted propellant system are based on the structure of the G-91. They show a pair of small turbojet engines along one on each side below the main Bristol Olympus turbojet powerplant. In one form of the patent, these engines are fixed and have pivoting exhaust nozzles to direct the jet blast at an angle between full aft and full forward. In a second arrangement the engines are hinged mounted to swing through an angle of about 15 deg. down, rear-

ward and parallel to the thrust line. Fiat's system draws dual Fiat Gamma, G-91, which, when the compacted system, increases the use of the gamma engine thrust to the low speed and low altitude flight regime. For this reason, the engines can be designed to low engine operating speeds for lift and thrust between overloads, so that the thrust-weight ratio can be increased.

Gabellini believes that since as high as 10 can be reached with engines properly designed for this job.

Specific figures used to determine the potential of the system are based on the G-91 using a Bristol Olympus 12 rather than its current Olympus 5 engines. Gabellini stresses that the thrust-weight ratio for the engine system would have to be about unity in order to make the plane a true STOL performer. Installed thrust of the Olympus 12 in the Fiat G-91 would be about 60% of the aircraft weight, leaving the remaining 40%—or about 5,000 lb.—to be reached by the thrust of the two light engines.

Small turbojets in that thrust category now exist, one of the best known examples is the Rolls-Royce RB 108

engine used in the Short SC 1 VTOL research aircraft. That engine has been further developed in the RB 146, a powerplant rated at about 2,500 lb thrust and developed specifically as a high thrust-weight ratio engine.

For the Olympus 12, thrust-weight ratio is better than unity at the nominal static thrust rating of the engine, not using the afterburner. With thrust, the thrust-weight ratio is about as close as 7:1.

Thrust-weight ratio of the Rolls-Royce engine is believed to be considerably higher than unity.

The engines shown on the Fiat patent drawings are obviously not Rolls-Royce powerplants, and in fact, resemble the centrifugal compressor turbojet engines that Fiat has been developing during the past few years.

One of these engines, designed specifically for the auxiliary requirements laid out by Gabellini in his patent application, would be the type of powerplant used ultimately in the compacted system for the G-91.

Another engine shown in the Fiat drawings is approximately 22 in. in maximum diameter and on the order of 18 in. long, measured from the re-



GRUMMAN F-11C—LARGE-GEARED—WING 2 TRACK, early winging airplane for Navy carrier operations, carries long range radar detector equipment

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INCIDENT 103 A, designed for long over water flight and low altitude hovering—eye sighting in water—during water exit ejection sequence



## Sud Voltigeur Tactical Support Plane

Sud SE 117-85 Voltigeur tactical support plane prototype is powered by two Turbomeca Astor turboprop engines producing 750 shp each. New fuselage section has been slightly enlarged from the configuration of the SE model which carried about a rear gun

to fit things in the normal cockpit place. Installed engines would be longer, but cost the tailplane would be modified to take other landing controls or to increase to make the last more air directional.

General's use the compound propeller system is more attractive overall than using turboprop engines, or other means, or the modified thrust area to get the airplane off vertically.

It is said that the main propeller can be driven in the form of three separate air masses in reverse speed performance in level flight, and the engine propellers can be pulled for best performance during climb and landing approach. This allows optimum use both portions of the propeller's action, and yields much better speed

weights for the installed engines. Both sets of engines use the main aircraft fuel, and do not require an auxiliary system for fuel introduction to the engines. Separate controls must be provided and possible separate inlet systems.

Current status of the GPR project is a paper study with considerable weight of calculations behind it. Evaluation is being done by the French Weapons Development Firm, and the status of the project depends on these assessments.

Based on the GPR design, the proposed propeller system would require the current fuel supply and high-speed performance of the plane while increasing substantially its climb and landing performance.



## A3J-1 Reorward Ejector Capped by Tail Cone

Tail cone firing even opening for removal system of water from the Navy North American A3J-1 twin jet interceptors. Activation of the system triggers before that release the firing with the star (AVIATION WEEK, p. 11), p. 11 with an emergency ejection



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Figure 1 shows the design of a generator pump in a form of internal gear pump. The design of a generator pump in a form of internal gear pump. The design of a generator pump in a form of internal gear pump.

Figure 2 shows the design of a generator pump in a form of internal gear pump. The design of a generator pump in a form of internal gear pump. The design of a generator pump in a form of internal gear pump.

Figure 3 shows the design of a generator pump in a form of internal gear pump. The design of a generator pump in a form of internal gear pump. The design of a generator pump in a form of internal gear pump.

Figure 4 shows the design of a generator pump in a form of internal gear pump. The design of a generator pump in a form of internal gear pump. The design of a generator pump in a form of internal gear pump.



Figure 5 shows the design of a generator pump in a form of internal gear pump. The design of a generator pump in a form of internal gear pump. The design of a generator pump in a form of internal gear pump.

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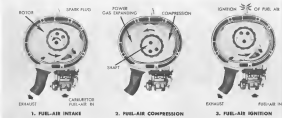
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ROTATING combustion engine displays the stages of a four-stroke engine with one rotation of the tapered rotor.

## Curtiss-Wright Proposes Business VTOL

By Barry Falk

New York—Curtiss-Wright is developing a six-place business VTOL aircraft powered by a Curtiss-Wright rotating combustion engine. It has licensed and is now producing the concept in preparing for VTOL use.

The poppet of lightweight steel and glass fiber construction is designed to produce a lift force as well as thrust when turning in a plane perpendicular to the line of flight. The VTOL vehicle will rely on the lift during forward flight with vertical takeoff and landing thrust achieved by tilting the fuselage. Additional advantages given by the rotary engine include aerodynamic efficiency and automatic power plants (AWP) Nos. 16 p. 316.

Plans for the poppet and VTOL vehicle were disclosed in Curtiss-Wright's 1959 annual report (AWP Feb. 29 p. 34). Other projects mentioned in the report include research of new business turboprop aircraft platform, a ground-effect air car and light vertical takeoff aircraft. No mention was made of any turbine or rocket engine.

Wright Aircraft Division is currently in production with its J45 turbojet engine as well as total recuperating engines. Curtiss-Wright and its parts business for engines as the Turbo Comp powered R1190 and R1120 is expected to receive substantial for some years.

Res. I. Shuler, president of Curtiss-Wright, told the Society of Automotive Engineers at New York that the corporation's distribution and development

effort was aimed at the aerospace and technological needs of 1965. Shuler disclosed the rotating combustion engine in detail in an effort to show many aspects about the design. The rotating combustion engine, known as Curtiss-Wright, was developed in 1940 by Curtiss-Wright.

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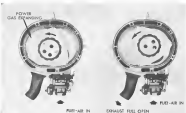
The poppet of lightweight steel and glass fiber construction is designed to produce a lift force as well as thrust when turning in a plane perpendicular to the line of flight. The VTOL vehicle will rely on the lift during forward flight with vertical takeoff and landing thrust achieved by tilting the fuselage.

Additional advantages given by the rotary engine include aerodynamic efficiency and automatic power plants (AWP) Nos. 16 p. 316.

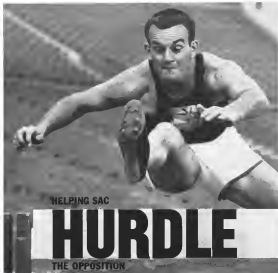
Plans for the poppet and VTOL vehicle were disclosed in Curtiss-Wright's 1959 annual report (AWP Feb. 29 p. 34). Other projects mentioned in the report include research of new business turboprop aircraft platform, a ground-effect air car and light vertical takeoff aircraft. No mention was made of any turbine or rocket engine.

Wright Aircraft Division is currently in production with its J45 turbojet engine as well as total recuperating engines. Curtiss-Wright and its parts business for engines as the Turbo Comp powered R1190 and R1120 is expected to receive substantial for some years.

Res. I. Shuler, president of Curtiss-Wright, told the Society of Automotive Engineers at New York that the corporation's distribution and development



4. POWER STROKE—GAS EXPANDING—INTAKE OPENING—EXHAUST CLOSING  
 5. EXHAUST  
 CRANKSHAFT of the engine is geared by the rotor at a ratio of 3 to 1.



SAC is now off and running with its new Hound Dog missile. With the superpower GAIM-77 missile, the B-52 bomber can more easily hurdle ground defenses on the way to a target. In the short span of just 30 months, the Hound Dog air-to-surface missile grew from the drawing board to a powerful member of SAC's defense team.

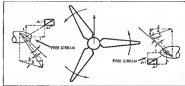
Following enemy ground defense centers while the mother ship speeds on toward the main target is just one of the jobs of the versatile GAIM-77 missile. When beneath the swept-back wings of a B-52, a pair of GAIM-77s can either clear a path for the bomber, or be sent right in as the main target itself. This triple-threat capability lets a single B-52 command a target approach corridor over a thousand miles wide.

To further confuse the enemy, these partially-guided missiles can loiter at pseudo-targets before turning toward their real objective. Speed and altitude variations can also be programmed into the GAIM-77's target approach.

The Hound Dog missile greatly extends the useful life and striking power of SAC's B-52 bombers—the backbone of America's strategic power. The GAIM-77 is being produced by the Missile Division of North American Aviation.

**MISSILE DIVISION**

**NORTH AMERICAN AVIATION, INC.**  
Downey, California



STEEL AND GLASS-FIBER pistons is designed to produce lift as well as thrust.

tation. The geometry permits the three species of the ribs to seal the combustion by maintaining contact with the periphery of the chamber. The total ring cost is mounted on a movable which controls the eccentric rotation and gives the speed down to one third that of the driver shaft. Thus the rotating combustion engine provides the power sequence for each crankshaft revolution, two times that of a single-cylinder four-cycle compressing engine. Additionally, the power sequence of the rotating engine covers a wider crank angle than that of a reciprocating engine: the ratio being 5 to 2.

The rotating combustion engine is valued by means of simple intake and exhaust ports. As the chamber expands over the open intake port, the intake mixture is forced in. The moving ratio then seals the combustible mixture and compression it beneath the spark plug which fires the charge for the power sequence. Contractions of the chamber over the open exhaust port discharges the combustion products. Ports may be located either on the sidewall or in the periphery of the chamber.

Provision lubrication of the engine is provided by means of jets within the rotor to lubricate ports. Carlin-Wright reports using SAE 5 viscosity oil to lubricate its test engines. Each Carlin-Wright engine successfully completed a two-hour type full oil routine lubrication, however, that was deemed

sufficient for larger displacement engines due to the dirt exhaust products.

Liquid and air-cooled rotating engines are planned. Development models include liquid cooling, but Carlin-Wright says that the bearing can be heated to any degree necessary for air cooling. The engine is not self-venting. Carlin-Wright says that the bottom part reaches 200-240°F. The elimination of exhaust valves decreases the possibility of detonation. The cylinder sports flat even with low intake fuels, detonation is virtually unknown.

Real success has been achieved successfully on some development models. Wright says that the engine is well suited for fuel injection but in the interests of simplicity, standard carburetor carburetors have been used instead of the Wright engine. The company reports that supercharging also is possible with the engine and that supercharged models are under development.

The major portion of Carlin-Wright's development work with the rotating combustion engine has been with a 60 cc or 100 hp single cylinder engine called the EAC-1. All engineering data information by the company concerns the engine.

The 100hp 3RC6 engine employs a 7 to 1 compression ratio and turns at 7,000 rpm. (Wright has run the engine to 8,500 rpm in NSR lab open and under engine at 17,000 rpm.) The torque curve is fairly flat from 2,000 to 6,000 rpm at about 100 ft. lb. but specific fuel consumption is 47.

The engine delivers 168 hp at 5,500 rpm—equivalent to 1.87 hp per cc. or with a wet port intake. The same engine with a ported intake port developed 174 hp at 5,500 rpm—equivalent to 2.05 hp per cc. or Wright reports. Wright starts work with an atmospheric intake or at cold ambient temperatures.

In rotating combustion engine will be developed as a conventional engine. Carlin-Wright reports. The engine has two main moving parts and only the rotor and combustion chamber have to be precision machined. No need

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## Here is a man you should know he's a **DEHAVAN FUEL INJECTOR SPECIALIST**

His name is Robert Ulrich. He's the Senior Project Engineer on Fuel Injector Development with Delavan. He's been with Delavan ten years, and has designed fuel systems which are now standard on many of the world's most advanced jet aircraft and missiles. Men like Bob Ulrich, concentrating their considerable talents in fuel injector development, have made Delavan the world's largest single specialist. They're the men engineers leading turbo-jet, turbo-prop and APU manufacturers rely on Delavan for fuel injection problem solving.

If fuel metering and distribution are part of your product, take advantage of Delavan's specialized experience and proven ability to deliver aircraft quality. Send specifications to the address below for obligation-free recommendations.



engineering tolerances will reflect for the other engine components.

Against these advantages for the rotating combustion engine are some problems, which up to now, have hindered development of the Wright design. These design problems and Curtiss-Wright's answers to them include:

• **Sealing the combustion chamber** at the apex of the truncated cone has been a chief development problem. Sealing is performed by blade-like metal seals which seal the sides against the peripheral wall of the expanded chamber. Wright says that it has developed a more rugged seal which has proved satisfactory. The key to the seal problem was the development of a tough, resilient metal seal, the alloy of which Wright considers proprietary. The company reportedly ran one of its 100-hp models for 100 hr under load, then inspected the components and ran it for another 100 hr.

• **Ignition of the engine** represents another design problem. The single spark plug in the rotary combustion engine is fired almost continuously, leading to shortened plug life, fouling and pyrolysis. This would be a serious problem in aviation applications of the engine but Curtiss-Wright says that its ignition system is satisfactory.

• **Chamber distortion** is another possible work item on the design. The problem is that combustion is constantly taking place at one point in the precision-machined chamber. NGU has developed metallurgical treatment to harden chamber walls sufficiently to withstand the temperatures and pressure. The endurance tests of Curtiss-Wright lead to believe this is a design flaw at least in the 100-hp model.

• **Scaling the engine** upward is one, while not a known problem area, is venturing into the unknown. NGU is currently working with small rotary engines in the area of 125 cc (3 cu. in.) displacement. Curtiss-Wright's development work has been centered around a 60 cc (3.75 cu. in.) 100-hp displacement engine. Two ways of increasing output power of the rotating engine are by increasing the displacement of a single chamber or by starting the combustion chamber along a constant circumference. Curtiss-Wright intends to do both. The company reports that it is designing a 1,000-hp single-cylinder engine as well as a 5-hp micro-turbine engine.

Curtiss-Wright has selected both dies and its initial 100-hp rotary propeller. The propeller, now undergoing static tests, will require a minimum of wing area. The company says that its VTOL aircraft will be capable of rising to 18,000 ft. in vertical flight and to 16,000 ft. in forward flight, according to engineering studies. The company expects an estimated date when its VTOL vehicle will make its first flight.

## 27 million jet flight hours

... demonstrate General Electric's leadership  
in the design and manufacture of jet engines

From the historic moment in 1942 when twin General Electric I-A engines powered the first jet flight in America, G-E engines have logged 27 million jet flight hours. And, G-E jets like the J33, J36, J43, T38, J35, J39, and CJ-606 have consistently set new standards of performance and reliability.

Today, a General Electric engine:

- Powers the aircraft which has possessed the world's speed, altitude and turn-to-climb records all at the same time—an unprecedented triple crown.
- Shone in the Collier Trophy for "the greatest achievement in aviation in America" during 1958.
- Has been chosen to power the world's newest and fastest commercial jetliners and the first American turbine-powered commercial helicopter.

**GENERAL ELECTRIC**

## 27 million jet flight hours mean *Reliability* for air-breathing weapon systems

For almost two decades jet thrust has been increasing rapidly. G.E. has helped lead the way. Each new G.E. engine has added to a remarkable record of reliability. Today, the J79-powered Lockheed F-104 has established an outstanding in-commission rate with USAF.

Sea forces will soon be strengthened by the McDonnell F4H and the North American A5J—the fastest, highest-flying aircraft in Navy history. USAF's fastest, highest-flying bomber, Convair's B-58, is J79-powered. And, USAF's J79-powered Lockheed F-104 has held simultaneously the world's speed, altitude, and time-to-climb records—an unprecedented triple crown.

At the other end of the flight propulsion spectrum, G.E. small gas turbines will soon enter operational service with the Air Force and Navy. The Navy's newest ASW and utility helicopters will be powered by the T58, which has demonstrated its reliability in thousands of demanding test hours.

The high performance J65 turboprop will soon enter USAF service powering McDonnell's GAM-72 dummy missile and Northrop's T-38 jet trainer.



**J79** After more than three years of production, G.E.'s J79 remains the most advanced U.S. production turbojet. The record-breaking J79 provides more than 13,000 pounds of thrust, yet some models weigh as little as 3200 pounds. J79-powered aircraft have logged considerably more than half the world's Mach 2 time. Six Mach 2 air weapons are J79-powered: McDonnell F4H Phantom II, North American A5J Vigilante, Convair B-58 Hustler, Lockheed F-104 Starfighter (all pictured in series above), Grumman F11F-1F Super Tiger, and Chance Vought Republic II missile.

**J65** Advanced aerodynamic and mechanical design make G.E.'s J65 turboprop the highest thrust-to-weight ratio powerplant in its class. Weighing just 820 pounds and delivering 3650 pounds thrust, the robust J65-5 powers Northrop's T-38 Talon supersonic trainer (pictured in main illustration) and M-162F Freedom Fighter (right). Another J65 version (above), which weighs 365 pounds and produces 3450 pounds thrust, is the powerplant for the McDonnell GAM-72 dummy missile (right).



**T58** The T58 brings important benefits to helicopters—increased payload or range, faster cruising speeds, greater endurance. Engines shipped have averaged significantly better shaft horsepower of 1050 shp, 616 BHP, and 371-pound weight. A 1350 shp growth version enters production this year. T58 has been duplicated in single and twin-engine helicopters including Sikorsky's HO4S (left), HO4C (left), and S-62, Kaman's HO4S (left), and Vertol's VHC-1A and H-10D.



**T64** Low SFC and attractive power-to-weight ratio make G.E.'s versatile T64 turboprop/turboshaft ideally suited for a variety of aircraft. Among them: helicopters and fixed-wing designs (right), skisuits, new VTOL-STOL designs. Turboprop configurations, with gearbox above or below compressor, deliver 2670 shp at 323 BHP. Turboshaft versions produce 3350 shp at 326 BHP. All models have constant power sections, differ only in gearing and accessories.



GENERAL ELECTRIC



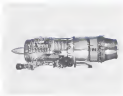
27 million jet flight hours mean  
*Thoroughly Proven Powerplants*  
 for commercial aviation



G-E engines will be the most thoroughly tested yet to enter airline service. For example, General Electric's CJ-805-23 flight test program was the first of its kind ever undertaken by a U.S. manufacturer at his own expense to test a commercial turbojet under flight conditions. The CJ-805 powered Convair 440 (top) has exceeded all of its performance guarantees and performed reliably in flight test. Delta Air Lines' first Convair 440 established speed records on its maiden coast-to-coast flight.

Jetliners powered by CJ-805-3 or -33 engines have been ordered by American Airlines, Avianca (Venezuela), Capital Airlines, Civil Air Transport (Formosa), Delta Air Lines, REAL (Brazil), Scandinavian Airlines System, Swissair, and Texas World Airlines.

At the other end of the power spectrum, America's first turbine-powered commercial helicopters, already on order by all three of the nation's major helicopter airlines, will be powered by G-E CT58 engines. Next entered stage: turboization of helicopters and transports owned and operated by industry.



**CJ-805-3** G-E's first commercial engine, the CJ-805-3, enters airline service this spring. It will provide the power to carry passengers in Convair 440 jetliners at 415 miles per hour. The CJ-805 weighs 3800 pounds, delivers more than 11,000 pounds of thrust. It is 51 1/2 inches long, 38 inches in diameter.



**CT58** The CT58 is the first U.S. turbojet to be FAA-certificated. It will power the twin-turbine Sikorsky HO4S and Vertol V107 (both in more than 1000 hours of flight) and the CT58-powered single-engine HO4S in being offered to helicopter operators and corporations.



**CJ-805-23** General Electric is flying testing its latest B-46 with off-the-shelf CJ-805-23 engines. When tests began, it marked the first time an engine manufacturer had test flown a turbojet engine in the primary powerplant of an aircraft. The twin all-ten engines are performing reliably—proving themselves prior to airline service. CJ-805-23 engines will power the Convair 440 and Convair 440.



**CF700** Compared to turbojets in its class, the CF700 turbofan will provide higher thrust per dollar, greater range, shorter take-off, and less noise. The CF700 will combine the proven J65 gas generator and a scaled-down version of the CJ-805-23 fan to produce 4000 pounds of thrust at 6000 SFC. Flight worthy CF700's are scheduled for April, 1961, with FAA-certificated engines available in February, 1962.

## 27 million jet flight hours mean *Greater Capability* for tomorrow's aerospace missions

Twenty-seven million jet flight hours form a solid foundation upon which General Electric research and development can build to meet the needs of the near and distant future.

The Mach 3 North American B-70 Valkyrie bomber, for example, represents the next stride forward for manned aircraft. G.E. is developing the highly advanced J93 engines which will power it.

General Electric, under contract with USAF and the AEC, is developing a nuclear propulsion system for America's first nuclear-powered aircraft, as revolutionary as the B-70.

In rocket, VTOL, and space power and propulsion, systems now being investigated at General Electric will help make propulsion progress.

To achieve the challenging objectives of the present and the future, G.E. applies its knowledge and experience, and maintains R&D facilities among the most complete in the nation.

G.E.'s more than 100 research laboratories strive for new basic knowledge which can be applied to aerospace progress. For example, at the pioneering General Electric Research Laboratory, basic research is leading to advances in metallurgy, cryogenics, and other sciences vital to aerospace progress. These activities supplement the direct efforts of extensive aircraft gas turbine R&D facilities at Evendale, Ohio, and Lynn, Massachusetts.



**J93** The General Electric Mach 3 J93 will power the North American B-70 Valkyrie to cruising altitudes above 70,000 feet and speeds of more than 1000 mph.



### NUCLEAR PROPULSION

This special test assembly was designed and built by General Electric under contract. It consists of a nuclear reactor, shield, controls, and two modified J47 engines. General Electric first successfully operated a turbojet on nuclear power in 1955. Development progress is continuing.



### TOMORROW'S VTOL

Currently under development, General Electric J47 gas turbine jet engines provide for a new generation of aircraft, which can take off straight up, hover, and move forward at high speeds.



### ROCKET POWER

Development concepts at G.E. include plug nozzles on gases (below) which are considerably smaller than conventional engines of the same thrust.



### ION ENGINES

In the void of space, a few ounces of thrust can control vehicle flight paths. One way to achieve this thrust: electrical propulsion. G.E. is investigating an ion engine which electrically ionizes gases, such as cesium, to produce thrust.

GENERAL ELECTRIC

## Milestones

in General Electric's 27 million jet flight hours



In 1942, the first jet flight in America was General Electric's powered Twin J.A. engine (above) powered the Bell P-59 at 450 mph.



The J47 powers Boeing B-47 Stratojet bombers, backbone of America's deterrent strength during the past decade.



North American's P-86 Sabre Jet, powered by General Electric J47's, scored a 14-1 victory ratio in Korea.



America's first Mach 2 engine, the J79, won accolades for performance and reliability. Vice President Nixon (center) presented the Collier Trophy to (left to right) GEAF Vice Major Walter Irwin and Lt. Col. Howard Johnson, G-2's Gerhard Neumann and Neil Burgess, Lockheed's Clarence Johnson for P-30A-278 design and flight.

GENERAL ELECTRIC ENGINES POWERING THESE AIRCRAFT HAVE FLOWN MORE THAN 27 MILLION JET FLIGHT HOURS				
RELI XP-59A BTH XP-52 BOEING P-17 BOEING XB-58 CHANCE Vought RESEARCH I GRATE BC-335A COMNAV P-30 COMNAV 340 COMNAV 340-42	COMNAV BP-61 DOUGLAS RB-66A DOUGLAS RA-58 DOUGLAS XB-42A DOUGLAS XP-53 DOUGLAS XP-50 DOUGLAS P-55B GRUMMAN F11F-1F MARAH R-100	LOCKHEED P-80 LOCKHEED P-30A MARTIN XB-48 MARTIN XB-52 McDONNELL RA-10 McDONNELL-144M-72 NOORTHROP P-45 NOORTH AMERICAN P-46 NOORTHROP P-60	NOORTH AMERICAN P-59A NOORTH AMERICAN XB-1 NOORTH AMERICAN G-1 NOORTH AMERICAN X-10 NOORTHROP P-156 NOORTHROP P-134 NOORTHROP XP-55 NOORTHROP YB-45	REPUBLIC BP-64 REPUBLIC XP-44 REPUBLIC XP-51 RYAN RB-1 RYAN RB-23 SKAGSBURY P-55 SKAGSBURY P-52 SKAGSBURY P-52B WHEEL 142-14

FLIGHT PROPULSION DIVISION

**GENERAL ELECTRIC**

CINCINNATI, OHIO AND LYNN, MASSACHUSETTS

## AVIONICS

### Officer Cites Proposal Improvements

By Philip J. Klaus

New York—Suggestions for cutting the cost of preparing engineering proposals for the military services and increasing their effectiveness were described here by Capt. F. W. Evans, Jr., officer of Naval Material, during the recent Institute of Radio Engineers Convention.

The ARCs of successful proposals, Evans said, are accurate, brief and clear, and their cost is supported by technical honesty and design simplicity.

Capt Evans made these general recommendations for improving the effectiveness of technical proposals:

- **Eliminate padding and repetition.** Save time and computer propaganda clutter the proposal and sell you as Evans said. Because individual sections of a proposal frequently are written by different persons, there often are discrepancies, inconsistencies and/or contradictions.

- **Improve clarity.** Use brief, sharp, focused sentences and paragraphs with precise, accurate, definitive descriptions. Clutter, thereby, means less chance of misinterpretation by military proposal evaluating personnel.

- **Restricted use of color.** Expenses, overhead and use of color should be kept small to situations where they contribute to presentation clarity and not add words or "window dressing or camouflage" which can actually detract from the engineering proposal, Evans said.

- **Speed up the amount of funds necessary to conduct your technical and management meetings.** Evans said, "as a simple, such authorized officer." Evans said, "no one should a company, spend more than it can afford to lose."

#### Choice of Contractor

In evaluating technical proposals the military services are looking for products which meet or exceed all of the specifications, technical performance and reliability requirements and which achieve a significant advance in the art, Evans said. The services also want delivery on schedule plus realistic and reasonable costs.

In addition, Evans said, the services prefer to work with a company that has:

- **Outstanding technical capability** in the specific branches of science, research or development.
- **Adequate facilities on hand**, or the willingness to invest in such facilities, needed for research, development, test-

ing and production, if the latter is required.

- **Demonstrated capability** in product engineering, production control and management.

- **Quality control organization**, staffed with competent personnel, that reports to a top management official who is not directly responsible for engineering or production.

In addition, Evans said, "there is a distinct advantage to contracting with a company having a management which is not only competent and experienced, but also is familiar with and actively interested in the program for which a proposal is submitted." One advantage Evans said, is to whether a company's management has the facilities and interest in which senior management and engineering representatives participate in proposals or whether third and fourth tier personnel are used.

One of the most important sections

in a technical proposal, Evans said, is the initial summary because it is read by more persons in positions of authority than any other part of the proposal. Its objective must be to convince the prospective customer that the company is fully able to meet his needs. The summary should be brief, preferably a single page, but no more than two or three.

#### Writing the Summary

The summary should include the following, according to Evans:

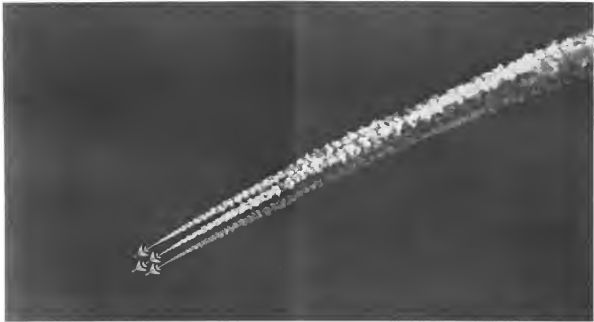
- **Clear, concise statement** of technical requirements which the proposal fulfills, or in the case of an unsolicited proposal, the particular problem area involved.
- **Brief analysis** of the problem which proposal will solve.
- **Company's proposed method** of solution.
- **Relative of proposed solution** to



#### Astron Amplifier Multiplies Electrons

Ultra-sensitive light amplifier called the Astron, employing two stages of electron multipliers, makes visible individual electrons released by photoemission tubes when hit by a single photon, according to Westinghouse Electric, which developed the device. Five stages of multipliers increase single electrons to 1,000 electrons which are accelerated by 20,000 volts to release more than 20,000 photons of visible light when they impact on fluorescent material at output end of the tube. Astron is useful for photo transmission, astronomy and nuclear physics.





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Delco-Remy's research and development program in electrical components of high reliability for advanced weapon systems currently includes: • Sensors • Servo Systems • Power Sources • Power Generators and Converters • and Precision Measure Relays.

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This flexible escape slide developed by Air Cruisers for jetabliners gives rapid and safer emergency evacuation of passenger aircraft, particularly at extreme aircraft attitudes.

The passenger's speed of descent is automatically reduced by his own body weight bending the last portion of the flexible slide closer and closer to a horizontal attitude as he nears the ground. Rate of descent is virtually stopped as the passenger eases off the final

few feet of slide resting parallel on the ground.

Simple to operate, Air Cruisers escape slides are standard equipment on many turbine-powered military and commercial aircraft.

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pool in dollars and time so that the contracting officer can carefully re-evaluate the specifications and decide whether to alter the requirements. It can be disastrous to leave these facts only after thousands of man-hours and millions of dollars have been expended. Even added.

The detailed presentation also should state where company expects to derive from established outline specifications, understanding to what degree and why it is considered necessary or desirable. Presentation should give an estimate of maintenance procedures and schedule required for the system and to what extent special test and/or support equipment will be required.

If the company must develop new components for use in the proposed system, it should so state and explain why existing components cannot be used. Evans warned that companies should not give the appearance of proposing new component developments because of a "sales-oriented bias" attitude. Air unusual or unique component reliability requirements, something that normally obtained from conventional components should be described and justified.

Where hardware is to be supplied the company should indicate whether it will be suitable for production or whether partial or complete re-engineering effort would be needed before design could be placed in production.

Capt Evans suggests that a company indicate where its proposed hardware is

related to existing or previous programs within the company, his data for other customers, including the customer project identification and funds already spent on the previous program. If the company proposes to use its proprietary information or techniques, it should be stated.

Estimates by company, contractors as to the likelihood of the program resulting in usable hardware can be helpful to the military evaluation, but such proposals should be clearly identified as estimates.

Military proposal evaluation can be limited in looking what type of organization will be employed in the pro-

posed program, i.e., will a special group be formed or is emergency-response personnel planned? If a special group is to be formed, its position as an official company organization, the kinds of its activities and responsibility should be stated. If no special group is to be formed, the proposed method of operation within the overall company structure should be described.

Capt Evans continued that companies should only list technical personnel expected to be assigned to the specific program, according their particular technical qualifications for the project involved.

In describing facilities, a company

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Ben-Av's four typical Aircraft Turbine Engines that make your engine ready for maximum service.

Oil pressure and temperature are read in many different parts of the engine — by using a variety of possible instruments before they move. The volume of oil moving through the engine is measured, too.

Ignition systems are checked with a Schenck turbine engine. This makes sure every component is functioning properly.

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An extra large oil and fuel flowing system extracts the most engine power. Four times during the test, a large change in torque occurs on a five hour test run.

We should add a 600 Airwork engine — an advance in standards above normal factory requirements. Airwork's turbocharged engines are economical because you are in operation. Can we send you pictures?



### New Electron Gun

New electron gun for hydrogen tubes permits major increase in power of order by providing an electron beam five times more powerful than previously, according to Space Electronics Co. which developed the device. Gun can provide electron beams of more than 200 megawatts power and 5,000 ampere current for high-power tubes. Gun also is reported to extend tube life.

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electro mechanical field... strong corporate financial backup... excellent field service... no one offers quite so reliable a package of solid state power as Western Design. For detailed information, contact your Western Design representative or write us for Data File AW-1029.)



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SANTA BARBARA AIRPORT, SOLETA, CALIFORNIA

should be those available which it plans to use for security, development, production and testing, with a description and estimate of cost and delivery of any new facilities which the company proposes to procure for the program. Evans says a firm also should give a summary of its test equipment and calibration program.

- Capt. Evans cites the following as the most frequent shortcomings of proposals received by the military services:
- Overqualification of the technical personnel or equipment.
  - Misinterpretation of the specifications, or failure to comply with them.
  - Lack of understanding of the technical requirements.
  - Proposed engineering program is not technically feasible in the available time.
  - Over-optimism in performance estimates of proposed equipment.
  - Inefficient design in cost and power consumption.
  - Lack of liaison with respect to how proposed equipment can be integrated or made to work with other planned or existing equipment or operational philosophies.
  - Proposal contains vague generalities and/or sweeping statements which reflect the philosophy: "We understand your problem, just give us a contract and leave it up to us."

Capt. Evans said that unsolicited proposals frequently are rejected for the following reasons:

- Funds not available for such a program at the time it is received.
- Weapon (turret, missile, ship) for which new development is proposed will soon be phased out of service.
- Proposed program infeasible in too far out of phase with weapons and development timetable of weapons with which it would be used.
- Need for proposed equipment is not established or it offers too little improvement to justify cost and effort.

Capt. Evans said that a company does its research as well as staff a distributor when it comes up with a broadly conceived and rapidly needed solution but to sell the military services because of a poor proposal.

### Infrared Tracker System Tests Readied at WADD

USAF's Wright Air Development Directorate soon will begin evaluation tests on prototype model of the AN/AAR-21 infrared search track system for intercept use, developed by International Telephone & Telegraph Corp. System employs two infrared tracking heads to provide both target bearing and range information. WADD does not conduct the type of infrared detector used, but says it is cooled to liquid nitrogen temperature

## THE HELPING HAND OF



## PRECISION AIRCRAFT AND MISSILE PARTS AND ASSEMBLIES

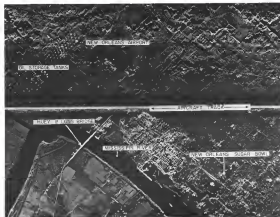
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**SADAR PHOTO** of New Orleans from 5,000 ft. altitude was taken by AN/APQ-15 side-looking radar developed by Texas Instruments for USAF. Side-looking radar enables aircraft to approach target without alerting enemy reconnaissance systems when search and ground-hunting radar sweep in with conventional forward-looking radar. Photo, made with X-band radar, shows a target moving along river (right to left). When head-oned by aircraft track results from side-looking radar blind spot.

## Side-Looking Radar Takes Aerial Photos

Dallas—Side-looking radar mapping systems that can provide high-resolution aerial photographs for tactical information on a road-the-chuck, base and can penetrate cloud cover, rain or fog with little or no degradation of range has been developed by the Air Force by Texas Instruments, Inc.'s Aerospace Division here.

A small number of production units have been delivered to USAF's Tactical Air Command and further contracts are now being negotiated.

The X-band system, designated AN/APQ-15 (X-15), is designed to map from piloted or unmanned aircraft carrier aircraft at groundspeeds from 200 to 500 kt., and altitudes ranging from 5 to 50 mi. made on either side of the aircraft. A later version can handle 100-150 mi. altitude and weather conditions will have the capability of mapping at groundspeeds

of up to 2,000 kt., according to Texas Instruments.

System is designed for operation at altitudes of 1,000 to 5,000 ft. Weight is approximately 150 lb., and its modular makeup permits major components to be located in various portions of an aircraft, if necessary, because of weight and balance limitations. Turnaround is extremely fast. A Texas Instruments-developed electronic switching circuit permits use of a single radar equipment to look alternately from either side of the aircraft through side-looking back to back beam-shaped area antennas measuring 8 ft. at 12 ft. long.

Another design feature is that objects at the edge of the photos are unobscured at the same scale as at the center, whereas on conventional aerial photographs, ground distances tend to be compressed in perspective as the distance to the scenes increases.

The Texas Instruments radar system can scan a constant ground area while providing side-looking and conventional forward-looking radar. A wide area of low altitude to record detail without perspective distortion according to the computer. A moving target indication also permits selection of targets to record the amount of activity in an area. Radar "shading" shows in the side-looking radar scene phase measurements of heights and depths of objects on the ground.

Radar returns are depicted as a single modulated trace on the outside of tube and recorded on film. A Texas Instruments-developed film-pulling mechanism carries the five-inch wide film past the trace on the tube face perpendicular to groundspeed and altitude, thus providing a continuous high-resolution strip. Film magazine is easily removed and replaced to provide continuous mapping coverage during a

WHEN IT COMES TO SHIELDED WIRE



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on the ferrule



**SLIP**  
in the ground tape



**CRIMP**  
the three together



**SNAP**  
on the insulation

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How's that for speed? And the post-insulation of the Termshield Shielded Wire Ferrule is easily and quickly accomplished . . . you eliminate close tolerance cable stripping required by other techniques . . . you eliminate blind probing of taps into other type ferrules . . . you eliminate solder and burnt cable . . . you eliminate lost time . . . you eliminate doubt.

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IN THE LAST FOUR YEARS:

## Honeywell has produced more Precision Miniature Accelerometers...



**GG16 ACCELEROMETER**, typical of Honeywell's miniature precision line is designed as a component unit for the MDG gyro area below. The GG16 is for detection of low moving parts, high reliability and a life expectancy of 10,000 hours.



**GG170 MDG**, typical of Honeywell's Miniature MDG MDG gyro line, contains small size and light weight with high accuracy. It is particularly applicable for use in closed circuit automatic systems and in close time control and radar control systems.

and more  
Miniature Integrating Gyros  
than any other manufacturer!

It's only natural that Honeywell, world's largest producer of gyros, should have produced more miniature integrating gyros and more precision miniature accelerometers in the last four years than any other manufacturer. But what does this mean to you, the customer? Just that the experience Honeywell has gained in building over 30,000 board gyros and over 20,000 accelerometers has been directly applied to our MDG line and our precision miniature accelerometers.

Although the GG40 Miniature Integrating Gyro was introduced by Honeywell four years ago, it has been continuously improved in accuracy and dimensional stability. New models have been added to meet various performance requirements so that Honeywell now has the most complete line of Miniature Integrating Gyros in the industry. These rugged MDGs are especially tailored to meet your requirements for advanced fire control systems, gyro reference systems, inertial navigation systems, missile navigation systems, and missile tracking systems.

Honeywell precision miniature accelerometers also reflect Honeywell's gyro and accelerometer experience. Honeywell miniature accelerometers, precision-balanced to ensure optimum reliability, are now available in angular, linear and integrating types.

Honeywell is eager to work closely with your systems engineers—occupying gyros and accelerometers into your systems and developing modified or custom size control components to meet your special needs. For further information, write Minneapolis-Honeywell, Dept. AW-4118, 2000 Ridgway Road, Minneapolis 14, Minnesota.

**Honeywell**  
 *Military Products Group*

# THE GRAND CENTRAL REPORT

## RESEARCH INGENUITY—AND NITRASOL

That wonderful American ability to fix almost anything with a piece of baling wire often seems lost among the complexities of an age in which almost any problem requires a nine-figure budget.

That this "baling-wire" ingenuity is an unalterable American heritage was re-established recently by Dr. Leon Foreman, former college chemistry professor, now in Grand Central Rocket Co.'s Research Department.

A very interesting new solid propellant, Nitrasol, was being developed at GCR. It had great promise, but there was no commercial way to schedule a test batch in one of Grand Central's large complex motors.

Dr. Leon Foreman was given this problem to study. Before anyone realized the significance of what he was doing, he had brought a polyethylene waste bucket at the dime store, attached an air-driven shaft and propeller, and, with this equipment costing \$150, tested the first test-size batch of Nitrasol. It was cast and fired—with complete success.

So efficient was Dr. Foreman's waste-bucket mixing technique that GCR scaled up the batch size to a one-ton-a-day capacity in constructing the nation's first commercial pilot plant for Nitrasol. With typical team aggressiveness, GCR personnel built the new plant in eight weeks. During the first three weeks of operation, thirty-five Nitrasol rocket motors were mixed, cast, and successfully tested.

Today the Nitrasol mixed in this new plant—revolutionary in its simplicity and low cost—offers a new promise to America's future in propulsion.

Produces Apps for chemical engineers  
and solid rocket production specialists

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Rocket Co.**

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EASTLAND, CALIFORNIA



angle light. Actual usage with its three sensors, the monitor being given to recording time, altitude and other pertinent data automatically with ground range recording.

System also provides for sensitive, transmissive radio coupling via weathering imagery to ground base, using microwave data link, communications equipment developed here.

Applications of the AN/APQ-55 family have included a mission flown for the Coast Guard during a critical sailing period when weather conditions rendered other methods of studying the ocean impossible. By means of the AN/APQ-55 equipment, the Coast Guard was able to map through the dense fog and get topographic interpretation of the seabed, sea and flow and determine break-up areas.

Further developments of equipment now under way include capability of providing range of acoustic location measurements within moments after the aircraft makes its pass to give moving target indication, with mapping data also transmitted directly to the land. Another advanced option provides long-range, high-altitude capabilities with system resolution that is independent of range.



► **New Semiconductor Microwave Modulator**—New type of modulator, consists of germanium rods or thin plates in a co-axial, which achieves 50% modulation of microwave power with little or no change in frequency or phase, was described by Army Signal Research and Development Laboratory specialists at the semi-conductor R&D convention. Semiconductor material has small allowed junction located along its sides to admit energy means required for modulator action. The report was prepared by Harold J. Paul, Paul A. Hest, Michael Bennett and Richard Bennett.

► **Solar Relay Appears Doubtful**—Use of the sun as a passive communications relay appears possible but not too far off, at least at present, according to a study made by Radio Corporation of America's Donald H. Blumstein. Because of the distance to the sun and the strong solar noise presented by the sun itself, extremely slow data rates would be required, Blumstein indicated, as well as extremely large antennas. Added optimism is the 15 year time lag time required to bounce a signal off the sun. Optimum frequency would be about 40 mc, RCA studies indicate.

► **FAA To Test New Radio-Evaluation**—Tests of a new terminal use radar developed by Bendix Radio, the AN/TPN-

34, which often more than double the range of existing Federal Aviation Agency terminal area radars will begin shortly at the National Aviation Facility Experimental Center (NAFEC) in Atlantic City. Radar, originally developed for the Air Force, is one of two experimental radars built to test. NAFEC will evaluate radar's performance as a terminal area aid and also use it as a terminal-transition radar (apt for newly developed data processing system).

► **Garage To Build New Dischargers**—Conger Associates, Palo Alto, Calif., has been licensed by Stanford Research Institute to manufacture and market the new common static dischargers developed by SRI's Robert L. Tasson (AW Mar 14, p. 32).

► **Radiation Resistant Transducer**—Report—significant progress in the development of power transducer and transducer capable of sensing temperature of 500C and nuclear radiation is described in new report, "Ultra High Temperature Power Transducers and Indicators," PB 16104, now available from the Office of Technical Services, Department of Commerce, Washington 25, D. C. The 576-page report, based on a program sponsored at General Electric by Wright Air Development Center, is priced at \$7.90.

► **Signal on the Detroit Line-Navy**—contract awards announced by various manufacturers include the following:

► **Northrup Co.**, \$10.5 million in contracts from Army Ordnance for construction, research and development on truck-mounted systems.

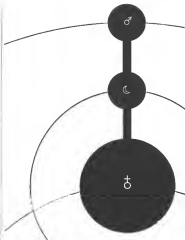
► **Northrup's** Navigation Division, contracts totaling \$22.6 million for one-third production and engineering work on Hawk missile.

► **Chicago Aerial Industries**, Melrose Park, Ill., \$8.23 million Navy award for KA-18 contract to be used on support vessel jet aircraft. Also, USAF contracts totaling \$360,000 for production of reconnaissance imaging equipment.

► **Leas, Inc.**, Santa Monica, Calif., \$2.75 million additional funding from Bell Telephone Laboratories for two reference units to be used in Nike Zeus anti-CBM (anti-air) tests. New contract brings Leas' total awards for Nike Zeus to \$4.3 million.

► **Bendix Instruments, Inc.**, Fullerton, Calif., will deliver 15 atmosphere radars to the Navy for an anti-air submersible under two awards totaling \$447,115, from Navy.

► **International Telephone & Telegraph's** Telecommunications Division, Clifton, N. J., will supply beacons, antennas and test equipment associated with Tacon to the Navy Bureau of Ships under contracts totaling more than \$2 million.



## SYMBOLS IN THE SKY

The Moon (☾), Mars (♂) and other planets are getting closer to our doorstep (☿).

A great distance from the huge complex of industry, science, military and civilian workers, are building the vehicles which will soon make the planets our next door neighbors.

California General—laboratory of sciences for rockets and satellites.

as a significant part of this team.

California General studies this individual and scientific complex—and its contribution to the conquest of space—the 20th century miracle.

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## NEW AVIONIC PRODUCTS

### Test Equipment



• Oscilloscope, Type 401B, a general purpose, low-frequency scope which boasts synchronization performance comparable to high-priced, wide-band frequency scopes, is available at \$450 from the manufacturer, Alfa B. De Moya Laboratories, Inc., Glens, N. J. Internal and external sync in-

cludes dc coupling, trigger leveling, single sweep, and automatic reset. Characteristics include sensitivity of 16 mv/cm with vertical horizontal and vertical amplifiers bandwidth of 500 kc at 5 db points, gain and pattern stability better than 2% over 8 hr and drift averaging less than 5 mv/hr.

• Voltage reference source for calibration of instruments, data reduction and laboratory component is available in portable and rack-mounted models which weigh 8 lb. Base unit is a 6 decade, decade-by-decade device with full scale of  $\pm 111.1$  v in 1 mv steps. Other characteristics: stabilized to 0.1%, ac line drive 100 mv, reference

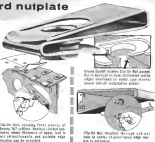


• Memory core tester, which verifies the operational status of a 1968-1980 address core memory, is available for standard relay test interfacing. Core memory test can be made on selected addresses and bits or in sequence on all addresses with every combination of the 19 bits. Test may be stored, interrupted or restarted from any address with any word pattern. Tester acquires 104 to 125 v a.c. 50-60 cps, and is priced at \$10,500. Paddock Bell Computer Corp., 1901 Annetest Ave., Los Angeles 25



## Monadnock self-locking CLIP-ON NUT to replace standard nutplate

Eliminates costly reworking in structural and non-structural installations. Applied where variable edge margin exists or through cut-out hole in center of panel, Clip-On Nut quickly slips onto panel or structure and locks firmly in both hole. Available for 6089 to 1507 application thicknesses. No tools required. As integral part of a sub assembly, Clip-On Nut eliminates additional drawings, part numbers and variations in field assembly coordinated with conventional locknuts. One reference measurement reports a savings of 33¢ each time a Monadnock Clip-On Nut is used in place of standard. Clip-On Nut refines inventory, simplifies design changes, field rework, repairs. Meets MIL-N 25027—120,000 psi class. Write for bulletin.



Clip-On Nut, showing three points of design 1967-1980. Another limited use, when design of panel has not been established and suitable size might not be provided.

Clip-On Nut, showing how to apply clip-on nut to center of panel where edge not yet in existence.

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## Components & Devices

• Rotary waveguide shifter, MA783, is rotatable for use in XG-45 U.S. band applications. Operating voltage is 20 to 28 v d.c. current at 25 v, is 300 ma and coil resistance is 15 $\Omega$  in 50 ohms. Is



closed position, the shifter provides 15 db attenuation in open position. Insertion loss is 0.2 db max and react is a max of one. Unit will operate under 5 $\mu$  minimum for 10 to 900 cps and to  $\pm 40$  to 100C temperature range, according to spec. Microwave Associates, Inc., Burlington, Mass.



• Delay lines, in which 150 tapered conductive sections are packaged in a cable and, are available with delays of 0.1 to 25 microseconds, 100 to 2,000 ohm impedances. 100 l dbm to rise time rates and attenuations as low as 0.005 db. Delays from stock, in two weeks is offered by manufacturer, Vaco Instruments, Inc., 13314 Greenleaf Rd., Gardena, Calif.

• Voltage-to-frequency converter, Model 2731A/R, permits dc and analog voltages to be converted under operating conditions with accuracies of better than 0.05 and 0.01% respectively for the two wide operating calibration error limits. The count of output pulses from these converters represents the true integral of the input voltage over the measured interval. The A and R models produce 10,000 pulses/sec for full scale input of 1 v and 100,000 pulses/sec



full scale respectively. Both units are priced at \$1,200 each. Palo Alto, Calif. Dinsco Division of Hewlett-Packard Co., 901 Page Mill Road, Palo Alto.

• Self-calibrating accelerometers, which require calibration before and during flight or seismic or seismic are available with side mounted connection (AS 1025) and with top mounted connection (AS 1020). Units have an acceleration range of 0.2 to 500 g and a frequency response of 1 to 5,000 cps. The AS 1025 ranges 21 grams, measures 1.15 in. in length and 0.95 in. in diameter. Accelerometers use dual sensor system

with one channel in the driver and the other the sensor to obtain the self-calibrating action. Sensitivity and repeatability of the output sensor element are rated at  $\pm 5$  mg/g max over and one revolution while the calibrating sensor element has 41 mg/g maximum sensitivity and 5 a standard maximum repeatability. Collins Industries, Inc., 212 Durham Ave. Menlo Park, N. J.

• Triaxial potentiometer, Model W 71, has resistance range from 10 to 100,000 ohms with a 10% tolerance. Avco Electronics, 7015 San Francisco Road, San Valley, Calif.

## SUMMERS

### STABILITY AND CONTROL SYSTEMS

At All Altitudes

Summers Build these systems for the KDB 2, Military Target made controlled by Bosch Aircraft Corporation. A total defense training device at bases around the world.

Summers components of the system include a closed, precision-rate (FAR) gyro, with angle sensor, two high-performance servos, an amplifier computer and an instantaneous vertical gyro.

## SUMMERS Gyroscopic Company

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GRYTON, OHIO WASHINGTON, D.C.

THE ALL NEW

# AERO COMMANDER 500A

first of a brilliant series featuring the

## *SPEED-LINE NACELLE*

a new, compact design that

**INCREASES SPEED  
and PERFORMANCE**



The sleek, new *SPEED-LINE* version of the AERO COMMANDER 500A so minimizes the frontal area that drag is inherently reduced! *FULLY RETRACTED GEAR* is neatly housed within the nacelle. There's *NEW POWER*, too. The 260 hp Commander engines feature *FUEL INJECTION*! And the 500A is capable of speeds up to 230 MPH!

The new design releases exhaust above the high wing making the CANN WHISPER-QUIET.

And the new *SPEED-LINE* companion provides *FULL-SLEEP VISION*.

The new *INTERIOR ELEGANCE* of the 500A decreases a rich blend of fine fabrics and genuine leather in your choice of beautiful colors. Call Whitney 9-5674 for complete details about the all-new AERO COMMANDER 500A, first of a brilliant, new series featuring the *SPEED-LINE NACELLE*!



# AERO COMMANDER



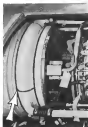


Flex-support door seal designed by General Electric is typical of advanced design features of the 880. General Electric silicone rubbers—with an outstanding resistance to temperature, ozone and aging—are used extensively on the General Dynamics Convair 880.

## General Electric silicone rubbers meet rigorous requirements of new Convair 880



Unique silicone rubber door seal incorporating spring steel flex-support, a feel safe feature that eliminates the danger of seal collapse—General Electric SE852, with twice the strength of regular silicone rubber, easily with-stands flexing of specially molded steel support. Over 600 wing seals and pressure cycling tests prove seal will meet all operational requirements.



G-E KTV high-temperature sealant is used extensively in piston and jet engines which hold G-E CH663 per engine. Liquid KTV (room temperature vulcanizing) silicone rubber is easily applied and cures without heat. KTV has excellent bond strength, good physical properties plus resistance to temperature extremes (180°F and above), ozone, weathering, moisture, aircraft fuels and solvents.



Now available: New G-E Silicone Rubber Selector. This guide will help you quickly select the right silicone rubber in line with your application requirements. In it you will find important data on applications, general classes, typical properties and special notes. Write for your free copy.

**GENERAL ELECTRIC**

Boxer 2421, Silicone Products Department, Watertown, N. Y.



### BMEWS Radar Components Tested

High power klystron tube (above), one of several used in AN/SPS-9 BMEWS surveillance radar, is 9 ft. high. Black cylinders surrounding the tube are cooling coils, tube is made by Westinghouse. Below are amplifiers and scanning switch for AN/SPS-9, shown under test at General Electric's High Military Electronics Department, Syracuse, N. Y. Diodeless (discrete) block set sensitive enough to detect objects as small as a needle. Scanning switch, housed in large tank at rear, rotates antenna in beam.



**BASIC BUILDING BLOCKS FROM KEARFOTT**



### FLOATED RATE INTEGRATING GYROS

Specifically designed for attitude applications, these Kearfott miniature gyros operate efficiently at unlimited altitudes. Their outstanding accuracy and performance make them superior to any comparable-sized units on the market. Heretofore sealed within a thermal jacket, these gyros are uniquely designed and completely adaptable to prebaked methods. Performance characteristics that are even more precise can be provided within the same dimensions.

#### TYPICAL CHARACTERISTICS

- Size: 1.5" x 1.5" x 1.5"
- Standard Operation: 1000 rpm
- Maximum Rotation: 1000 rpm
- Drift Rate: 0.001°/hr
- Accuracy: 0.001°/hr
- Temperature: 0° to 100° F
- Shock: 100 g
- Vibration: 100 g
- Weight: 0.7 lb
- Power: 100 mW
- Life: 1000 hours minimum

Write for complete data.



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GENERAL PRECISION INC.  
1000 PLYMOUTH STREET, NEW YORK, N.Y. 10011

## Boeing Plans Space-Exploring Missions



MODEL 554-1003 space vehicle conceived by Boeing for a manned earth satellite observatory has nuclear power source located at end of boom.



GENERAL PURPOSE space vehicle conceived by Boeing designers consists of two pressure vessels joined by an interlock or tongue-and-groove. Capsule, 74 in. long, small, is devoted into seven functional levels by nylon struts.

New York—Boeing Airplane Co., now on the threshold of space exploration with the Dyna-Soy project, plans to move into this field with a long range research program designed to stay in advance of present U.S. activities.

Details of this plan, prepared with approach the same precision that characterizes the government's own space-age program, were presented here at the Society of Automotive Engineers' National Aeronautics Exposition.

Taking its name, PAIRFACES (Program for Aeronautical Research and Scientific Experiments Concerning Space), from the astronautical term of distance, the Boeing program presently has eight different missions. For each mission, the company has designed the vehicle and systems required to accomplish mission objectives. Mission VIII is not to be considered the end of the program, according to Boeing Senior Vice President W. H. Beall, but rather, this is as far as the company's studies have progressed to date.

The eight missions are defined as follows:

• **Manned earth satellite observatory.** Research objectives for Mission I are better observation in the visible spectrum, observation in that part of the spectrum previously accessible from earth advanced geophysical research, weather observation and communication, and establishment of a communication link with research station. Boeing's current vehicle concept (Boeing Model 554-1001) for carrying out this mission is based on a general purpose, cylindrical space capsule, with a nuclear power source at the end of a long boom on one end and the cylinder itself is perched in a tripod-like structure on the other.

• **Remote relay.** Boeing's vision for going to the moon, Beall asserts, is that almost all the functions of the satellite observatory can be carried out there under more favorable conditions. A more ordinary vehicle would provide a more stable base for astronomical observations, astronomical observations, permit exploration of the lunar surface and could serve as an experiment station for minimal research in advanced space technology and in techniques for lunar manned exploration. Year activities.

A recent Boeing study, Beall reports, indicates that the same vehicle actually can provide the satellite observatory, in which case Mission I objectives would probably be re-evaluated. Earlier, Boeing made a definitive study titled,



## AEDC Tests Mercury Escape Rocket

Reliability of a 40,000-lb thrust escape rocket for the Project Mercury manned space capsule has been tested at a simulated altitude of 105,000 ft at Arnold Engineering Development Center's Engine Test Facility (left). Rocket motor is made by Grand Central Rocket Co. and can hold payload for 100 min.

"Lunar Observatory," for the USAP's Earth-Moon Division and Air Research and Development Command.

• **Counter-rotation.** Proposed as one of the most effective means of measuring the magnetohydrodynamics of the solar system, the counter-rotation would be a satellite observatory established directly opposite the moon and at the same distance from earth to provide, in effect, a reversed view of the sun. It would also aid in the development of full spectrum instrumentation and use of a lens-type deep space navigation device which would have a base leg of 484,000 mi. or so.

The Mission III vehicle concept, Boeing Model 554-2001, is again designed around the company's general purpose space capsule, this time with four booms extending from the capsule at right angles to each other. An array of solar cells in the power source and four ion rockets provide thrust for velocity and orbital corrections.

• **Interplanetary probes.** Research objectives of Mission IV are acquisition of physical and surface data from planets, study of radiation intensity versus solar distance and study of spatial matter distribution versus solar distance. For this mission, research engineers have designed a vehicle called the Boeing Marine Explorer (Model 553-4001) which, according to Beall, will depend upon the contract of manned geophysical facilities and will be adaptable for all terrestrial planets. It is a self-

propelled, self-guided, remote trip vehicle which will use solar cells or, for more distant trips, probably a nuclear reactor as the power source. Its rocket will be used for propulsion.

• **Close solar orbit.** Mission V would be devoted entirely to solar research, says Beall, but at this time it would be contemplated to put a set of research observatory. Boeing's solar probe is designated Model 555-0001 and, in one concept, it would make a series of passes in a heliocentric orbit with a period of approximately 10 million min.

• **Interplanetary observatory.** Primary purposes of the Tripod probe observations (satellite in stable position 60 deg. ahead of and behind the earth) is to observe both end of the moon's orbit distance from the sun (at the earth) or to provide a very long base leg for full spectrum, interplanetary observations. A long base leg for space exploration, and simultaneous view of planet placement, and communication facilities for general space exploration. Model 555-0001, Boeing's space vehicle design for this mission, is very similar to the vehicle concept for Mission VII and VIII, with all three built around the general purpose space capsule.

• **Out-of-solar orbit.** As in Mission VI, this mission will enable scientists to conduct meaningful deep space observations without the additional complexities of orbital or planetary maneuvers near the planets and without having to make

BASIC BUILDING BLOCKS FROM KEARFOOT



## 20 SECOND SYNCHRO

This synchro, just one of a broad line offered by Kearfoot, provides the extreme accuracy required in today's data transmission systems. Kearfoot's synchro requires enable system designers to achieve instant accuracy without the need for 2-speed screws and electronic electronics. By proper engineering, matches up to 24 motor control transformers can also operate from one receiver transmission.

## TYPICAL CHARACTERISTICS

Typ. Receiver	Capacity Transducer	Size 35
Part Number:	2011-001	2111-001
Input (volts)	110	110
Frequency (cps)	400	400
Primary (ohms)	400-500	8000-10000
Secondary (ohms)	100-150	1000-1500
Resistance Ratio	100:1	1:10
Max. Error	± 2	20 seconds
Accuracy	10 sec	10 sec

Write for sample data.



KEARFOOT DIVISION  
GENERAL PRECISION INC.  
LTD. MADE IN U.S.A.



WHAT WAS SINGER DOING AT FORT MONMOUTH? In this instance, Singer was working with U.S. Army Signal Corps engineers to advance the state of infrared art. At Fort Monmouth, and other installations of American defense, representatives of the Singer Military Products Division, are in constant—and productive—tandem. A division of The Singer Manufacturing Company, SMPD is composed of the Singer Bridgeport, Diesel Manufacturing Company and HRB-Singer. A comprehensive brochure describing these engineering and production facilities is yours for the asking.



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loadings. Mission VII vehicle will be established as a heliocentric orbit with the same radius as the earth's orbit but inclined to the ecliptic plane by somewhat more than 10 deg. This will allow researchers to enter into the true road of space, probe the depth and content of the solar corona and to obtain a global view of the sun and the solar system.

**Fluorocryt exploration.** The first broad spectrum of this mission are acquisition of planetary physical data, study of the planets' natural resources, sociological research and colonization. Interplanetary exploration is certainly far enough away in time, according to Bell, to provide a challenge for all our skills for many years to come.

At the heart of Bell's PARSECS program is the company's current design concept of a general purpose space capsule-vehicle around which most of its interplanetary research vehicles are designed. This structure, which is to be assembled in a geosynchronous orbit, is essentially a "rubber drugg" that can be expanded or compressed to suit the requirements of different missions.

From the outside, the capsule looks like a large cylinder with conical ends. Seen at least remotely on the concept of dual reliability, it actually consists of two separate pressure vessels (each a 15-ft-radius hemisphere joined to an ellipsoid with a maximum axis of 10 ft.) placed by the cylindrical housing for the control air lock or hanger deck. Overall length of the capsule is 74 ft and the air lock is 14 ft high at the vehicle entrance.

The interior of the capsule is divided into seven levels, three in each hemisphere and the airlock. These levels are control, atmosphere, fuel/oxidant stores, hanger deck or airlock, living, rest and recreation, and biophysical stores. Because the vehicle is generally

in the weightless state, nylon nets are adequate to separate the levels, according to Bell. Crew complement is 70 men. Each hemisphere is capable of housing the entire crew in the event that repairs have to be made on the other hemisphere.

Modifications of the basic structure for different missions generally entails the altering in addition of the basic attachments which hold the power and propulsion devices. The bonus structure, Bell pointed out, has been the subject of applied research in the living structures staff. It is constructed of thin-wall, double-corrugated materials which give an extremely lightweight structure adequate for the low head applications considered here while at the same time providing the necessary surface area and planning for cooking and transmitting the power system working load.

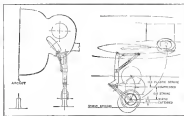
#### Other SAE Reports

High energy absorption landing gear, a plastic deformation concept, has been prepared to increase the safety and reliability of proposed VTOL aircraft. Aim is to increase the maximum operating altitude within the doppler flight regime and to eliminate the "moment out-of-control" (land crash) characteristics of aircraft.

By use of such a device, that would not rupture during abnormal landing, positive failure altitude capability above the ground can be increased to such an extent that the aircraft could operate during transition from vertical to horizontal flight without incurring an "extreme rotation zone."

Proposed was shown to the National Aeronautics Meeting of the SAE by Charles L. Wharton, Jr., senior dynamics engineer, Lockheed Aircraft's Missions, Ga., Division.

Today's aircraft, by comparison,



LOCKHEED described landing gear for VTOLs at SAE's National Aeronautics Meeting.

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avoid operation at a combination of low altitude and winged wheel, in event of power failure, a pilot must react with minimum delay in effect a landing without damage to the vehicle in possible regions to be used.

Plastic deformation of landing gear structure differs from the pneumatic failure concept in that the structure deforms plastically but does not rupture, the gear itself would be the last part of the structure to fail in event of abnormal loads.

With a conventional gear, tried Wharton, a severe enough landing to exceed break load will usually result in primary structural damage.

As part of the design strategy for VTOL aircraft, Wharton suggests a combination of plastic deformation with either a conventional air-oil strut or a liquid spring gear; a combination that would neither reduce a weight penalty nor penalize the performance of the aircraft.

Proposed landing gear installations was assessed for a jet-powered high performance VTOL airplane with these properties: maximum vertical lift-off weight, 7,500 lb., maximum wing weight, 4,500 lb., maximum vertical thrust (two engines), 7,665 lb., basic maneuver load factor, 7 g. Landing gear data: maximum elastic stroke, 1.25 ft., maximum load factor during

elastic stroke, 5 g.; load stroke energy absorption efficiency, elastic stroke, 80%; maximum plastic stroke, 633 ft., maximum gear load factor during plastic stroke, 5 g.; load stroke energy absorption efficiency, plastic stroke, 90%.

Design conditions for the elastic energy absorption device, which is located within the main vertical runway, were selected as follows: 15 ft/s rate of sink capability, 80% gear offset over factor, maximum stroke 15 in (excluding tire deflection).

Above conditions would yield a 5g center force peak and a 1g liquid compression spring peak. For a design landing velocity of 15 ft/s rate of sink, the maximum elastic stroke is approximately 10 ft/s for a rate of sink of 10 ft/s the total elastic plus plastic stroke is used up. Dynamic analysis shows a 30 ft/s complete power failure rate of sink capability for the 7,500 lb. aircraft. This would correspond to a complete power failure altitude of 113 ft., and Wharton.

For this particular application the total landing gear weight, excluding nac, wheels and bridle, amounted to only 3.5% of design gross weight. By comparison, past conventional landing gear for military fighter class aircraft are in excess of 4%, and the light observation class airplanes are in excess of 7%.

#### SAE Transport Reports

Superior transport reliability can be enhanced by designing the airplane's systems for monitoring by an airborne computer, according to C. L. Blak, transport systems development manager of Convair Division of General Dynamics Corp.

A limited version of such a computer already has been used in flight-testing the Convair 580 jet transport. Blak told the Society of Automotive Engineers meeting here.

An instrument called the "Advisor," jointly developed by Convair and the Johns Deere Manufacturing Co., has been operating in the 580 since the first test flight. Blak said. Blak showed a computer the instrument uses a small air-to-head "bug" driven by the computer. The bug moves around the periphery of the airport indicator and advises the pilot of the status of the taxiway and runway. If the pilot is proceeding unilaterally, the bug stays ahead of the airport mode; if the bug falls behind the pilot aborts his taxiway. The computer scans perimeter with all engine performance, fuel consumption and outside air data.

The Advisor has been further developed to advise the 580 pilot of his best climb speed, and such engine information as remaining stage and time at sea.



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great speed and altitude. It can tell the pilot the optimum speed and altitude he should fly for maximum range or for maximum endurance. In the event of an engine failure, the pilot can read the altitude for the given condition. It also gives him the optimum approach altitude.

Blake and the economies of important transport operations depend on high utilization of the airplane and schedule delays will be critical. Maintenanceability, therefore, is even more important than with general aircraft and the biological electronic computing routine offers a means of assuring reliability. With the plant's system designed to provide the computer with information, automatic checkout can be accomplished during flight. Further, it might be possible, ultimately, to carry out continuous computer checkout of the entire airplane and to eliminate unscheduled maintenance. Maintenance on the basis of statistical flight hours or experience also might be considered.

In connection with Century's B-15 bomber program, Blake said, "a full scale, multi-million dollar, electronic effort on reliability" has been made. This involves a full systems management program, with computer analysis now of all components, subassemblies and systems of the aircraft.

A possible means of curing the shock wave noise or sonic boom associated with supersonic transport airplanes was suggested in another report to SAE members by three Boeing Airplane Co. scientists, L. E. Blumberg, Y. A. Yeter and Y. Aho. Wind tunnel experiments have borne out the possible use of aerodynamic interference to reduce or suppress the boom effect, they reported. In effect, this involves designing the fuselage and wings, which are the two sources of sonic boom, so that their shock waves tend to cancel each other out.

A cost against the Mach 3 speed regime as the next transport development was made by B. S. Shernoff, chief engineer of British European Airways. An aircraft of the Mach 3.1 category, Shernoff told the SAE conference, can be produced by extrapolation of present aircraft, with either a simple wing wing or an M-wing.

On the other hand, a jump from subsonic to even Mach 3 aircraft would be enormous, Shernoff said, and both aerodynamically and in terms of structural materials it is a "leap into the unknown." Yet, the BPA officials said, cannot afford to bring any supersonic aircraft into service before the early 1970s, and then they should reach as far as Mach 3. He suggested that manufacturers who sell of Mach 3 and higher-speed transports now be using a "large public relations and

"steering-the-nose" battle" to divert the competition into "the most reasonable Mach numbers so that they can quickly and quickly produce a highly satisfactory Mach 3 aircraft in light of the, with the minimum of extra problems and a big bang enough for air action."

## Alperin Heads New Space Systems Firm

Space Systems and Industrial Automation, Inc., has announced appointment of H. H. Rosenthal, Drexel, Biddle Corp., for research, analysis, and development services in a wide field dealing with the physical, biological, engineering and non-engineering aspects of space technology.

President and technical director of the new company is Dr. Martin Alperin, who formerly was director of astronomical research and advanced studies for the Jet Propulsion Office of Scientific Research at AFOSR, he was responsible for monitoring advanced research programs in the upper atmosphere, space physics and propulsion as well as in the development of space automation techniques and facilities.

Associated with Dr. Alperin are a nucleus of scientists with experience in space vehicle analysis and design, including operations research, hypersonic aerodynamic analysis, life support, industrial and human engineering, as well as in the more conventional, computerized techniques of the physical and biological sciences.

## U.S., Italy to Launch Atmospheric Probes

Washington—U.S. and Italy will conduct joint sounding rocket studies of the upper atmosphere under the latter in a series of balloon space exploration tasks requested by National Aeronautics and Space Administration.

NASA has agreed with the Space Commission of the Italian National Research Council to join in a series of launches from the island of Sardinia, probably in September. NASA will furnish the meteorological balloons, and the Italian group will supply the sounding rockets and launch facilities.

U.S. also has reached agreement with Spain on the construction of a Mexican tracking station in the Canary Islands. The station will cost \$1.5 million, and construction is under way. Tracking launches and communications activity will be conducted in connection with the Instituto de Terrestre Astronomía, spouse of the Spanish Air Ministry.

Agreement also has been reached with Australia for Mexican tracking stations at Perth and Woomera.

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## Rotor Recovery Proposed for Boosters

By Edwin J. Bell

**Hunt, Tex.**—Workable rotary wing recovery system for large subsonic and sonic boosters could be obtained at a research and development cost that would be paid for with the first successful recovery of one such booster, Bell Helicopter Corp. engineers have contended.

U. S. Air Force, interested in such a system because of the savings of millions of dollars in valuable satellite boosters it could provide, recently asked industry to submit proposals on design for a rotor recovery system for boosters and the Mercury-type manned space vehicle, leading to building method configurations. Indication are that it plans to progress such development initially with Fiscal 1969 funds.

### Ground Rig Tests

Bell Helicopter engineers are presently engaged by the system because of their strong rotary wing background. They have tested ground rigs of tested configurations to obtain data on such a recovery system, utilizing folding rotor blades that would actually serve to brake the speed of a retreating booster, then fall away for slow final descent.

In its more sophisticated form, the recovery system would be tied to ground-based guidance to provide accurate spot landings in areas where the booster would be least susceptible to weather damage or post launch to populated areas.

The booster recovery system studied here concerns landings in the more developed regions relative to manned helicopters. An engine weight, it is considered the lightest of all the several methods studied, including fixed and

folding wing glider configurations and a parachute, plus impact-absorbing bag system. The rotor recovery system is designed to handle an empty booster and would be approximately 10% of the booster's empty weight or 1-1 1/2% of the entire vehicle and powerplant system.

Ability to provide an extended glide radius at the lower atmosphere is an inherent characteristic of the system, from an altitude of 25,000 ft. to 50,000 ft., a glide radius of some 15 mi. to 30 mi. is possible, Bell Helicopter engineers estimate, providing sufficient margin for accurate navigational recovery procedures. Implementation of a sensor-type altimeter would make it possible to maintain an effective signal at 30 ft. altitude to provide a soft landing. It is estimated that such a simple system would provide approximately 75% reliability in the final stages of pre-flight recovery and could be further improved.

Seven recoveries could provide landing the booster in an area the size of a football field from approximately 25,000 ft., Bell believes.

Studies thus far by Bell Helicopter engineers indicate that a rotor can be controlled at supersonic and hypersonic flight velocities in the up-flow and out-of-flight paths and that lifting action, approximating those of fixed wing configurations can be obtained for rotor in hypersonic flight. Folding rotor concept considered here would keep the blades straight until after the booster separates, dropping them at an altitude from 200,000 ft. to 20,000 ft. and at velocities from Mach 5 at the higher altitudes to Mach 0.5 at the lower altitudes.

Rotor blades would automatically curve sharply as fold under high drag conditions into a lower drag configuration, giving a high rate of maximum to minimum drag, the variation in drag compensating for the change in atmospheric density experienced in a re-entry maneuver and permitting deceleration to be spread over a long time and distance. This characteristic would permit utilization of slower re-entries with accelerations tolerable even to a human crew member, although there is a further loss, Bell notes.



**ROTOR TEST RIG** mounted on truck by Bell Helicopter Corp. engineers has been used successfully in checking spacing, timing, drag buildup characteristics, and control of rotor by reflective grids. Models showed it was possible to prevent rotor from turning by reflective grids mounted to start the rotor in a preselected direction, then stop it and start it turning in the opposite direction.



**ROTOR RECOVERY** system for Saturn-Norovian boosters is studied by Bell Helicopter Corp. rotor test rig. Inset, left, is guided to rotor recovery landing by ground-based radio guidance.

action tends to acquire temperature rise over surface also, centrifugal action of the blades can again be utilized to aid passing coolant fluids through them.

### Blade Feathering

It is understood that the blade feathering required to slow a rotor in a high lifting rotor attitude differs considerably from action used in a conventional helicopter. Dugout two-piece-invention cyclic blade feathering would be used for maneuvering sliding moments and produce pitching moment to replace the lateral and longitudinal one-piece-invention cyclic pitch feathering used in a conventional helicopter rotor.

The difference stems from the fact that velocity distribution over a rotor in slowed hypersonic flight causes the air flow relative to the blade direct everywhere on the rotor wing side of the blade surface that is not a retarded region on the retreating blades of a conventional rotor blade.

Proper collection feathering could be accomplished simply by kinematic arrangement of the control system, Bell points out.

Amphenol-Borg engineers indicate that line speed aerodynamic performance problems are expected to be experienced in design of a re-entry rotor that either retrograde, rotor rotor type, control can be readily accomplished by turning blade collective pitch setting by means of a simple mechanical governor.



## THE CANNON PLAN

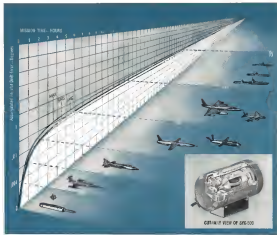
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low-wear spin wheel bearings contribute to a life in excess of 3500 hours. The Sperry SYG-500 is fully flight-proven on high performance aircraft. With full detailed specifications and supporting data.



## Helium May Cool Boost-Glide Vehicles

By Richard Swenson

Pasadena, Calif.—Injecting helium into the boundary layer in revolution to protect structures during high altitude maneuvers may be the key to solving the problem of high lift wings for atmospheric flight maneuvering and landing.

Current concepts, such as the Super X, have been designed to meet the requirements of the Air Force's X-45 program. The X-45, a manned aircraft, has been designed with low lift (three wings) combined with various structural techniques to solve heating problems which derange flight and landing characteristics.

The advantages of helium injection in boundary layer were indicated to California Institute of Technology researchers studying re-entry phenomena, including gas insulation and ablation processes and their relation to boundary layer heat transfer. Cal Tech scientists now seek to exploit it.

• **Phenomena involving helium's efficient insulation characteristics.** Research indicates that under steady state flight conditions which normally would produce 2,000°F to 2,500°F skin temperatures, helium insulation can reduce these values by as much as 40%.

• **Relationships in the ablation process,** resulting from combinations of re-entry shapes and materials.

This work is being supported by

the U. S. Army Ordnance Command.

Injection of helium into the boundary layer through nose or leading edge orifices at a rate of flow which does not disturb normal air flow causes the gas to remain in the boundary layer and act as an insulator. Relatively small quantities of helium produce very good cooling effects.

Helium's efficiency as an insulator is getting through space because of its lower thermal conductivity than other gases, as well as its lower specific heat. Comparison of helium with nitrogen shows that helium has a considerably higher specific heat, but comparison of other properties indicates that helium should be equally efficient. Helium has high thermal conductivity compared with nitrogen, and it has the highest diffusivity rate of all gas except hydrogen, considered above that of nitrogen. Helium's relationship also would indicate a theoretical advantage for nitrogen.

While Cal Tech researchers believe that the dominant factor in helium's efficiency is its high specific heat, future experiments will include measurements of helium concentration and temperature in the boundary layer. Measurements will be made of skin temperature with variations in helium injection rate and temperature in injection to compare values with free stream stagnation temperatures. These data will give a clue to factors responsible for helium's superior cooling efficiency over the gases.

Test shapes used so far have been bodies with a 0.75 in. nose radius, 3.3 in. diameter body and 2-in. length.

In heat transfer processes, at some point back along the body, the boundary layer without temperature reaches the equilibrium temperature of the free stream. Calculations by Lewis J. Lee, Cal Tech professor of aerodynamics and gas dynamics and director of the current research work, and his associates, indicate that the boundary rate of boundary layer temperature is almost that calculated by National Aeronautics and Space Administration, which is used as a standard. This rate of heating to the equilibrium temperature, which is close to the free stream stagnation temperature, may play a part in heat transfer processes related to the efficiency of a gas as a coolant.

In the ablation process (incorporation, evaporation, heat loss) and conduction in materials which respond at lower temperatures and point study of the process is in progress.

Research is being conducted in this context by hypersonic wind tunnels at Cal Tech, one capable of Mach 8, with a two-million temperature of 900°



SEQUENCE PHOTOS show, top to bottom, a 3-in.-dia. conical model as it changes shape during ablation. Photos were taken 5 in. apart. Thermal conditions were that of free stream moving at Mach 5.8 at 1000°.

and maximum Reynolds number of about 200,000 at air 7 in. x 7 in. test section. The second tunnel works at a maximum of Mach 6, 500° free stream. Cal Tech test results on ablation rates have shown good agreement with theoretical predictions of other researchers, leading to a high confidence factor in the methods by which these problems were made. Measurements of rate of shape change, supported by sequence photos, have been made on both the test and



**ICE MODEL** photos were taken about 5 mm apart in temperature tunnel at Mach 8 and 1000°K. Photo slightly rotates over time in left photo. It has been shifted to the photo on right, in the case of the rest of the model's surface.

carburizer models, with thermocouples embedded in the models to measure internal temperatures during the process. An ice model from Iowa Tech, an aerodynamic, has lasted for 10 runs at a 1000°K stagnation temperature. At 1000°K to 1000°K stagnation temperatures, models last 10 to 20 runs, at Reynolds numbers equivalent to aircraft approximating 200,000 ft.

The objective studies seek to determine the physical parameters and their relationships, including heat of sublimation of the material and composition rate.

#### Phenomena Verified

Cal Tech engineers have verified predictions that the effects of heat of sublimation increase with the rate of evaporation. The rate of increase depends on the molecular weight of the evaporated material, the lighter the weight, the more efficient the cooling. This is the most efficient form of the low molecular weight of the evaporated material.

For a high heat of sublimation, and since the tunnel operates at low pressure (three to four mm vacuum), the rate of evaporation is low. Since rate of evaporation is low, the rate at which the gas (product of evaporation) is introduced into the boundary layer is likewise low, and any possible effect of the gas in the boundary layer is lost.

However, using carburizer models, high rates of surface evaporation are achieved, producing the blowing effect into the boundary layer, and the process can be studied in detail over a period of time. Carburizer was selected after a search for materials with high vapor pressure (temperature also was considered), and model runs were the same as those used with ice. While internal temperatures of ice models were about -40°K, carburizer temperatures for carburizer models are about 1000°K, while stagnation at temperature of the interface is about 1000°K. Reynolds number ap-

proximately in the tunnel, and avoided a quasi-equilibrium stage.

One limitation Cal Tech researchers have encountered with temperatures and densities obtained in these facilities is the inability to effect a chemical reaction in the boundary layer, a process occurring at many aerodynamic temperatures. They now seek a material which would undergo a chemical reaction in the boundary layer at the temperatures and densities available in the Cal Tech tunnels. Reaction in these experiments have been in the order of 100 ft of atmosphere or lower.

The object is to produce the chemical reaction, or what occurs, and establish relationships of the chemical reaction to the other parameters of the atmosphere. Such chemical reactions are important to the long-term-high-temperature, which would occur in space vehicle re-entry. Without this chemical reaction, materials that they do not have the complete or true picture of the entire atmospheric process.

Researchers at Aeronautics and General Electric have reached some of the same findings as the Cal Tech researchers, but generally in more complex environments involving very high heat for short time exposure. These findings are being pursued, while the Cal Tech results are detailed.



#### Water Simulates Rocket Exhaust Pattern

Water jets at 20,000 ft thrust model superior in model at NASA's Lewis Research Center, Cleveland, Ohio, to reliably check the uniformity of spray which simulates engine flow and pressure. Water simulates about the same pattern as an actual ice flow.

## Subsidiary Shift Improves GPE Earnings

New York-Stonger controlled management that includes lighter cost control and integration of subsidiaries were major reasons for General Precision Equipment Corp.'s improved 1979 earnings. Chairman James W. Murray told the New York Society of Security Analysts.

Earnings of \$184,267 in 1979 on sales of \$105 million amounted to only 18% profit margin and failed even to cover preferred stock dividends. Last year, after a management reorganization, the corporation earned \$1,705,100 on sales of \$215 million.

Murray, who became chairman in the management reorganization a year ago, described the lighter integration that aided for strengthening GPE's 12 principal subsidiaries into an East Greenwich autonomous subsidiary—General Precision Laboratory, Kierulff, Lithuania and Lark—because four divisions of General Precision, Inc., an operating company formed to coordinate their research and development, engineering, production and sales.

A board of directors was formed for the new operating company consisting of Murray, Donald W. Smith, president of GPE, Dr. Raymond L. Gorman, vice president engineering and research for the parent company, and two officers of each division. It meets bi-monthly as often as to decide overall policy and to present data on company reorganization and re-evaluation of ideas.

"As separate subsidiary companies they were inclined to deal with each other as rivals," Murray said. "Thus we can present. We also believe that members of the board should be fully acquainted with the problems as well as the successes of each division. Particularly this is true in the future."

"Division management is responsible for profit. As the full impact of the sales build, we also are achieving better cost control in the other subsidiaries," Murray said. The new management is attempting to develop a new philosophy for the company and its subsidiaries. He described it as a simple case of watching expenses and costs, and of getting a good operational team that will add together toward an acceptable return on funds used.

For 1968, GPE had a profit goal of 10% on sales after taxes. Over the longer term, the company seeks a gross return of 15-20% on funds invested. This would include equity capital and long term debt.

#### Video Sonics Programs Studied

General Precision, Inc., is investigating Video Sonics, an audio-visual technique for improving production efficiency and spending production output. It is investigating, according to the Video Sonics system (AW No. 4, p. 71) and another system being studied by Donald E. Stewart, now head of Applied Communications Systems (AW Feb. 28, p. 71), previously in charge of Video Sonics development at Hughes.

To study applications, appropriate methods and flexibility of Video Sonics, General Precision is installing a test system at its Dallas Division and studying the results of its own market research program.

"Probs," Murray said, "depend on the right kind of controls as every function from research and development to sales. When it comes to preparing budgets for expenses and capital costs, we want our people to think things through as though they were spending their own money. 'Would you do it if it were your own business, would you spend it if it were your own money?' It is surprising how many responsive situations become optional when you consider them in this light."

#### Present Volume

GPE's present subsidiary-commercial volume is about 70-100%. The company hopes to increase domestic business, but also maintain an international business that much more to give a 90-95 split. To do this may require more acquisitions, Murray said.

As is the possibility that GPE still might be acquired by the Martin Co., which has been acquiring GPE stock on the open market for the last six months. Murray expressed no opinion. GPE's situation has discussed great Murray representation on the board, said, Murray estimated, Martin saw one out of 145 of the total common stock, but an action has been taken in the.

Murray and that as far as he knows none of Martin's executives hold GPE stock in their own names. GPE's own board now holds almost as much stock as Martin, he said. Other points involved on by Murray. \*Let transport acquisition delivered by Link last year were sold at a loss. Debit this year will not return a profit.

but will not be sold at a loss either. \*Beneath outlook, as projected now would save GPE (Kierulff) paper and printing equipment) until 1980. City beyond that time proposed would be left in 1981.

\*B-70 production contracts with General Precision Laboratory were awarded when the program was actually cut back, but have been restricted to allow GPE to complete prototype to bid began.

#### New Offerings

Electrodata Corp., Beverly Hills, Calif., announced in March, 1979, as Kierulff Electrodata Corp. and primarily categorized, through one or more of first aquatic subindustries, in the design, development, manufacture and sale of pressure vessels fabricated from titanium and used principally in nuclear, aircraft and other defense devices, intensive research for commercial jet aircraft, pressure, hydraulic and electrochemical systems and allied components, and data acquisition systems and systems and allied electronic components for utilization in radio, communications and television systems. Offering is \$40,000 shares of common stock. The public sale, offering price and underwriting fees to be supplied by underwriter.

The company reorganizes the purchase of all of the outstanding stock of Suburban Rubber Co. and initiate other acquisitions, after which it will also be engaged in the design, development, manufacture and sale of rubber processing devices, primarily for the aircraft and allied industries, and other molded and extruded rubber products.

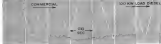
Frederick will be used for payment of the cash portion of the purchase price of the Suburban and affiliated company stocks, for payment of the portion of the notes constituting a portion of each purchase price, for payment of the balance of the purchase price of the stock of the Suburban and affiliated company (October, 1979). In agreement of bank, borrowings the balance for payment of other notes, advances to a subsidiary, and other purposes.

Debit Corp., Newark, N. J. organized in July, 1978, to act as the exclusive sales agent for the Debit credit light analyzer which was used in the process of the development and marketing of Debit Electronics, Inc., (see p. 124). Offering is 136,719 shares of common offered for subscription by common

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shareholders of record May 2, 1968, at the rate of one new share for each two shares then held, subscription price to be supplied by shareholders.

In October, 1955, Delta Corp. acquired the proprietary rights to the flight simulator and simultaneously granted exclusive U.S. manufacturing rights to Decca. In February, 1960, the company, by its acquisition of the equity ownership of Avionics, Inc. (in which Decca had assigned such manufacturing rights, because engaged in the manufacture of the flight simulator).

Proceeds will be used for the payment of 6% debenture notes in the amount of \$82,000, \$10,000 will be applied to the cost of acquiring additional capital equipment and for the expense of moving operations into a new plant in Norwood, the balance for additional working capital to finance production.

Microdot, Inc., South Pasadena, Calif., engaged in the design, development, manufacture and sale of precision communications connectors, miniature cable and transmission and other components and assemblies. Offering is 204,000 shares of capital stock, 60,000 shares to be offered for public sale by the company and 144,000 shares, presently outstanding, to be offered for sale by the holder thereof. Public offering price and underwriting fees to be applied by underwriter. Proceeds will be used to cover back loans incurred for working capital purposes, to pay in full promissory notes for the purchase of machinery and equipment, for property additions and improvements, for working capital.

Seawoods Petroleum Products, Inc., Easton, N.Y. (formerly Seawoods Accessories, Inc.), produces electronic, hydro-mechanical and mechanical systems, instruments, controls and drives for use in aerospace, water, nuclear, nuclear and commercial vessels. Offering is 112,500 shares of common stock, 100,000 shares for public sale by the company, and 12,500 outstanding shares by the general selling price and underwriting fees to be supplied by underwriter. Proceeds of the 100,000 shares will be added to the company's working capital, thereby reducing the amount of funds required to be borrowed under its revolving credit agreement and putting the company in a more favorable position to secure, through borrowings, such additional funds as required from time to time.

F. W. R. Inc., Woodside, N.Y., engaged in the design and manufacture of precision mechanical equipment and related instrumentation. Offering is \$3,000,000 of convertible subordinated debentures, due 1975, for public sale,

offering price, interest rate and underwriting fees to be supplied by underwriter. Proceeds will be used to repay short-term notes, up to \$175,000 will be invested in Mortenson Corp., a new corporation formed by a group of engineers and scientists in Los Angeles to develop and produce microwave components complementary to the company's products, remainder will be used to acquire new facilities in connection with the company's program for expanding its production and engineering capacities, to maintain additional inventory necessary to meet current and anticipated sales requirements, to supplement working capital and for other general corporate purposes.

Haldol News, Inc., Rockport, N.Y., engaged in the manufacture and sale of products for xerographic and photocopier production and for photographic use. Offering is 33,121 shares of common stock, to be offered for subscription by the company's common stockholders at the rate of one new share for each 10 shares held, the record date, subscription price and underwriting fees to be supplied by underwriter. Proceeds will be used to repay bank note maturing in 1970, and the balance will be added to general funds to be used primarily for increased expansion of xerographic equipment for leasing.

Stazo Industries, El Cajon, Calif., engaged in manufacturing component parts and standards for nuclear and aerospace, the company performs chemical milling services on a variety of air materials and parts. Offering is 248,800 shares of capital stock, to be offered for public sale, offering price and underwriting fees to be supplied by underwriter. Proceeds will be used to discharge notes and short-term indebtedness and long-term indebtedness to provide facilities and initial operating funds for an electronics equipment, to consolidate production facilities by transferring machinery and equipment into a leased plant, to build a chemical milling plant and to provide a chemical mill, for expansion of the chemical milling facilities and to cover initial expenses of establishing a separate research and development department, the remainder for working capital.

Laboratory for Electronics, Inc., Boston, Mass., principal business the research, development and production of electronic equipment for aviation and other military use. Offering is 75,000 shares of common stock, these shares are issued or payable on conversion in satisfaction of the debt conversion, 10% convertible subordinated debentures due 1977, which are to be called for redemption in May, 1968. An underwriting

group has agreed to purchase from the company at \$23 per share any shares received for use in redemption of debentures not converted on or before the redemption date. The company believes it will be advantageous to raise new capital in the near future to finance expansion and to achieve back loans, it contemplates the filing of a new registration statement in April, 1969, covering an offering of new common stock, which will be offered for subscription by stockholders.

## Acquisitions And Mergers

Asico, Inc., Woodside, N.Y., will acquire Cohen Laboratories, Inc., and Precision Electronics, Inc., through an exchange of stock. Cohen manufactures electro-mechanical instrument for analog and digital, Precision Electronics makes precision capacitors for transistors. Both firms are located in East Orange, N.J.

Kellogg Instrument Corp. has acquired Richardson Allen Corp., Collins Falls, N.Y., manufacturer of electrical equipment, for an undivided cash sum. The firm will be operated under its name as a wholly-owned subsidiary of Kellogg.

United States Undersea Cable Corp. has been acquired by Phelps Dodge Corp., Marketing Corp., Phelps Dodge Manufacturing Engineers, Inc. is Northrop Industries, and Epsilon & Graft, Inc., of West Germany. New firm will design and build underwater cable systems. Herbert H. Schwab, former vice president engineering at Phelps, is executive vice president and general manager.

Shareholders of Control Data Corp. and Control Corp. have approved a stock exchange plan under which Control Corp. becomes a subsidiary of Control Data. All of the 113,551 shares of Control Corp. stock to be exchanged for 55,179 shares of Control Data common stock, at a ratio of five shares of Control Data for three of Control Data.

Edison Industries will exchange its undivided interest of its common stock for 100% of the outstanding stock of Western Graphical Co. of America. Western Graphical is a privately-held, long-established company with \$15 million in assets. The company employs 900 persons and is engaged in graphical reproduction and electronic instrumentation development and manufacturing. Western Graphical will operate as a wholly-owned subsidiary with management and organizational structure unchanged.

# CONDEC

## Products for Aircraft and Missiles...

### Ground Support Equipment

The Condec 1500 is a new ground support equipment for aircraft and missiles. It is a new design, built to meet the needs of the aircraft and missile industry. It is a new design, built to meet the needs of the aircraft and missile industry. It is a new design, built to meet the needs of the aircraft and missile industry.



The Condec 1500 is a new ground support equipment for aircraft and missiles. It is a new design, built to meet the needs of the aircraft and missile industry. It is a new design, built to meet the needs of the aircraft and missile industry. It is a new design, built to meet the needs of the aircraft and missile industry.



### Electronic Test Equipment

The Condec 1500 is a new ground support equipment for aircraft and missiles. It is a new design, built to meet the needs of the aircraft and missile industry. It is a new design, built to meet the needs of the aircraft and missile industry. It is a new design, built to meet the needs of the aircraft and missile industry.



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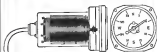
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## 60-CYCLE SYNCHRO INDICATOR



**Star 4000** is a 25T000S Synchro Receiver specifically designed for immediate installation in ground support equipment consoles or shipboard installations. Your choice of dial presentation which will accurately display the receiver or provide information received from a remote synchro transmitter. The receiver is ready for use with a 100 ohm load and is equipped with four .144 ohm equally spaced on 35 diameter. The receptacle provided on the receiver mates with an AMN100-145-25 plug. Power requirements are 135 volt, 60 cycle using 3 watts. The receiver is pressure sealed by "O" rings for protection against sand, dust and moisture. The receiver is available with a connector which the ground needs of MIL-8-38000.



Wright Coast Sales and Service—William W. Wright International, Inc., Portland, California  
Canadian Sales Office—Institute Health United, 3777 Lawrence Blvd., Montreal, Quebec, Canada  
Europe Sales and Service—Ruska International, 300 East 43rd St., New York 17, New York

Montrose Division

Satz 2.1.1 (Satz 2.1.1). Sei  $M$  ein Modul über einem Ring  $R$ . Dann gilt:  $M$  ist ein freier  $R$ -Modul genau dann, wenn es eine Basis von  $M$  gibt.

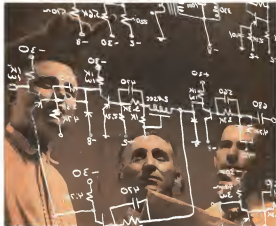
## Financial Briefs

Durham Rubber Co., Dayton, Ohio, has filed a registration statement with the SEC seeking registration of 38,604 shares of common stock, which the company proposes to offer in exchange for shares of the outstanding common stock of Metal Hose & Tubing Co. at the rate of one share of Metal Hose stock for three shares of Durham Rubber

**Darton Rubber** proposes to change its name to **Darton Corp.** The corporation and its subsidiaries are engaged in producing mechanical rubber products, foam cushioning products, plastic plates and chemical products, and equipment for the aircraft industry. **Metal Hose**, located in Des Moines, Ia., is engaged in the manufacture and sale of hose, and hose and components.

**Deanna Helicopters, Inc.**, has filed a petition for reorganization under Chapter 11 of the Bankruptcy Act to achieve a settlement with its creditors. The company, which is based in Dallas, Chapter 11 is a *debtor in possession* under which Deanna will be able to pay off liabilities of about \$1 million without going through formal bankruptcy procedures. Company also is striving to persuade its creditors to accept a plan to pay off the condition will be filed in U.S. District Court. Company also has filed a debt in Pennsylvania petroleum, continuing operations in Westport, Texas, and has 35 employees. Glendon S. Downum, president, says the company is discussing merger possibilities with "three or four concerns."

In August, 1959, Allied purchased all the business and assets of The Tuggerly Industries Division of Prior Manufacturing Company, Inc. for \$1,000,000 in cash, common stock and \$300,000 in debt. Prior Manufacturing proposed to distribute a total of 262,650 shares to Allied's 15 shareholders of the latter's acquisition of indebtedness represented by \$1,300,000 in cash, common stock and \$172,450.45, the balance of the stock will be distributed by Prior Manufacturing to its stockholders in proportion to their ownership of shares in proportion upon dissolution of Prior Manufacturing. M. H. Prior and G. L. Prior, Jr., at that time, owned 100 shares of Allied stock. Prior Manufacturing and the Allied stock to be distributed to them in a ratio suggested on the basis that the company has no evidence that they are indebted to the stock. Only 777 shares of Allied stock were to be distributed, as agreed, as the stockholders and debenture holders of Prior Manufacturing



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DIVISION OF UNITED AIRCRAFT CORPORATION

Stanford, Connecticut



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- RELEASE FROM LAUNCHING PAD
- RELEASE OF BOOST SECTIONS AND LAUNCHING PAD
- RELEASE OF TANKS AND JET/ROCKET BOMS

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By using the Nut's small explosive charge rather than the "brute force" explosive techniques so commonly used to fail high strength material in explosive bolts, the Separation Nut can instantaneously reduce a potentially hazardous condition to initiation stress and to the vehicle itself.

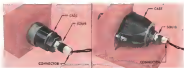
More compact joints can be designed since Separation Nuts are used in combination with standard diameter, high strength bolts used at full allowable.

Separation Nuts reflect another new listening concept developed in Hi-Shear's specialized engineering and laboratory test facilities for the specific needs of space vehicles and high performance aircraft.



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who will receive the balance of 25,377 shares have indicated no intention to subscribe there.

**Motors, Inc.**, earnings for 1999 were \$14,171,217, up 91% over 1998's earnings of \$7,356,131. Net sales were \$299,129,444, as compared with \$214,390,323 in 1998.

**Sevensolutions, Inc.**, reported a fourth quarter profit of \$75,000, compared with a loss of \$148,000 in a comparable period a year ago. Year's sales of \$15,100,000 and a loss of \$195,000 compared with sales of \$17,300,000 and a loss of \$45,000 in 1998.

**Long-Air Electronics, Dallas, Tex.**, which currently has a \$50 million backlog, posted a net income of \$1.5 million on 1999 sales of \$40 million.

**Flexible Tubing Corp., Guilford, Conn.**, reported 1999 net income of \$207,097 on sales of \$4,046,413. Comparable figures for 1998 were net income of \$46,741 on sales of \$3,564,319.

**Canning Glass Co.** last year earned \$24,315,699 on sales of \$294,887,424, an earnings increase of 41.3% over the previous year's total of \$17,163,543.

**Treway Engineering Co., Union, N.J.**, reported 1999 sales of \$4,731,660, compared with \$4,301,735 the year before. Income after taxes was \$100,682.

**Silicon Transistor Corp., Circle Pines, N.Y.**, reported a profit of \$13,000 on sales of \$111,000 during the last quarter of 1999. Backlog of orders exceeds \$200,000.

**American Machine and Metals, Inc.**, net sales for 1999 were a record \$51,063,417 compared with \$41,612,956 for 1998. Net earnings for 1999 were a record \$4,851,639, compared with \$2,246,612 for the previous year. Backlog on Dec. 31 was \$18,100,000. It was \$14,300,000 at the beginning of 1999.

**Galelli Co.** reports a net loss of \$536,984 for 1999 on net sales of \$28,816,353, compared with a net gain of \$145,068 in 1998 on net sales of \$21,825,669.

**Lead Electronics Corp.** set record sales of \$18.5 million for the first nine months of 1999 and earned record net income of \$179,000, compared with \$1.3 million net sales for the first three quarters of 1998 and net profits of \$89,000. Earnings per share for the nine months in 1999 were 75 cents on about \$65,800 shares outstanding. Earnings were 70 cents per share on about 300,000 shares in the 1998 period. Backlog of orders was \$30 million on Jan. 1,



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## NEW seminar series in practical vibration testing starts April at MB



Attendance at MB seminars is limited to 12 students per session in order to provide all with adequate opportunity to enter discussions and receive full benefit of laboratory equipment.

Every month 12 students "graduate" from MB's seminar in Complex Vibration Practice.

They return to the complex world of aircraft, missiles and electronics better equipped to handle the increasingly complicated requirements of vibration testing.

These well-known seminars were inaugurated by MB to familiarize engineers and technicians with the theory, design and operation of complex test equipment.

Results of these valuable training courses have been so successful that MB is pleased to announce a new series to run concurrently with the seminar on theory. The new seminar, starting this April, will emphasize practical application of test equipment.

The initiation and continuance of these seminars is another demonstration of MB's leadership in the field. They are good reasons why more and more engineers look to MB for continuing progress in the field of environmental testing.

### MB ELECTRONICS

A DIVISION OF TETRON ELECTRONICS, INC., 1025 State Street, New Haven, Ct., Conn.

## EQUIPMENT

# Low Frequency Unit Has Omni Properties

By David H. Hoffman

Roseton, N. J.-A computer and computer system that telescopes the problem posed to a pilot flying a low frequency instrumented approach into a "turn toward the runway" signal has been developed by Avco's Radio Corp.

Designated the Type CD-4 Course Director, the new ALC system leads the properties of a visual cueing to non-directional lighting, beacon-like seeking device, in effect, radio aids.

Navigating as an area without VOR service, a pilot using the CD-4 must tune in one LF transmitter and track to its down it by following an omnidirectional display on his instrument panel. In an approach, the program of the CD-4 coupled with an LF station comes close to existing that offered by VOR.

The CD-4, in addition, feeds steering information to the pilot, enabling him to turn toward and automatically as some optimum heading to intercept predicted arrival. Deviation of the course indicator's vertical needle is the pilot the direction of the total from his aircraft.

### Shared Gps

Conferring its own shared gps for heading information, the service operates through most conventional low frequency and VOR services now in use. Failure of the CD-4 computer section, however, will not affect normal operation of the VOR. In addition, ALC equipment installed as the aircraft conventional heading using the audio signals of an LF stage VOR as the ALC pointer still can be executed.

Flight evaluation of the CD-4 conducted by Avco's Wessex proved that a pilot-by selecting a desired course, taking his receiver to a ground station, selecting the instrument's proper operating mode and flying to enter its receiver can solve a wide range of operational problems with the CD-4 without changing procedures.

To be placed on the commercial market in July at an initial price of about \$3,000, the completely transistorized ALC system combines three major elements:

- **CA-144, Computer Amplifier:** Core component of the system, the computer amplifier consists of an aluminum frame with five plug-in modules. It drives the CD-4's directional gyro and computer transmitter to furnish stabilized heading information. The computer also generates a d.c. voltage equivalent

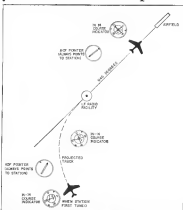


CHART illustrates an ALC approach in an aircraft equipped with the CD-4 Course Director, an LF receiver and appropriate radio facility charts. Pilot's procedure is to tune station frequency, set course indicator to memory heading, position mode selector of control unit to CD ADF and fly aircraft to correct vertical needle.

to the difference between aircraft heading and desired track. This is combined with a second d.c. voltage taken from an LF/VOR localizer transmitter, which indicates angle displacement from the selected course. These two voltages are translated into steering information by the computer and presented to the pilot as a signal to fly left or right.

• **IN-14 Course Indicator:** The IN-14 is a monometer equipped with a vertical and horizontal pointer. It serves as a deviation indicator, course reference and in-bound instrument. When the computer section is engaged, the vertical pointer supplies steering information to intercept and maintain a selected track. With computer disengaged the vertical pointer shows only track displacement.

- **G-62A, Control Unit:** The control unit's six position rotary selector switch links the system's steering computer to, or isolates it from, the status tuned on the aircraft's receivers. Depending upon selector switch position, either steering or track displacement information is displayed by the vertical pointer. In addition, a two-position NORM-KEY switch will move the pointer of the vertical pointer erect, causing into-the-needle turn on headings responsive to the course selected.
- **G-144, Slaved Gyro:** The slaved gyro replaces the vacuum operated directional gyro installed in most instrument equipped aircraft. It represents 1/3 of the system's 15.2 lb. total weight.
- **CT-10 Computer Transmitter:** The CT-10 is a magnetic compass that transmits heading rate to the slaved gyro.



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SYSTEM components include CD-40 Compass Transducer (left), IN-14 Course Indicator.



G-924 Control Unit is shown at left, at right is G-HA Stated Ops Compass.

through a self-contained synthesized DC-14 Slaving Motor. Mounted in a low diameter tube on the aircraft instrumentation panel, the slaving motor is a converter (5-6-6) millimeter coil used to monitor the gyro during current. Avionics Wase slaved the CD-40 as a regulated IFR light that took Aircraft Radio Corp.'s Twin Beacons from La Guardia Airport, N. Y., to Bridgeport, Conn., to MacArthur Field at Long, N. Y., and then back to La Guardia.

### Flight Evaluation

With the CD-40's mode selector on MAG, HDG, heading, heading-in which the vertical needle shows only displacement from the preselected heading—an instrument takeoff was simulated on Runway 11 at 11:11 a.m. The vertical needle had been centered and the ADF receiver tuned to La Guardia LF Ranger while the plane was in takeoff position. Course indicator read 312 deg. Wind was out of the north west at 15 mph.

On last takeoff roll, ABC's test pilot G. V. (Mike) Swick kept the needle centered with small rudder corrections. Angling gently toward the left, the Twin Beacons broke ahead about 15 ft from the runway's centerline.

At 1,600 ft over the Bronx and under dispatch center's radar surveillance, the CD-40's mode selector was switched to ADF ONLY, revealing its computer section responsive. To determine the most direct course to the airport, the located ring around the course indicator was rotated until the vertical needle centered. Triangular index of the course indicator showed that the airport, located about 1 mile southwest of Runway 31's takeoff end, was on a track of 095 deg. from the aircraft.

While the Twin Beacons was still on runway heading, changing the CD-40 mode was selected, engaging the CD-40 steering computer. Full deflection of the vertical needle called for a turn to the right and indicated that the 095 deg. track to the La Guardia Range was north of the aircraft.

Continuing at the needle—the signal to roll out—was received on a heading of 090 deg. The computer automatically rolled for an intercept angle of 085 deg., but as the desired track was approached, this angle was decreased by a series of turn right signals that brought the Twin Beacons gradually into course.

Course coupling followed by constant displacement of the vertical needle, in the exact manner of an area instru-

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engineered rubber*  
**CONSULT STONER FIRST!**



**FORMING THAT EXCEEDS THE TENSILE STRENGTH OF RUBBER** is achieved by Stoner's exclusive bonding process.



**LOWEST PRICES ON SILICONE RUBBER PARTS** are now possible through Stoner's new free location process. Savings are possible on both parts price and original forming costs.



**SOLVE YOUR RUBBER PROBLEMS WITH STONER'S SBR, Silicone and Feed Rubber.** This unique patented rubber makes a reliable sealant and thermal insulator and can be adhered built right into the rubber.

Photo courtesy of Applied Chemical



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## BENDIX IGNITION, CONNECTORS, CABLING PERFORM TO PERFECTION IN B-52G "HALF MILLION" TEST

Bendix® Ignition Systems, Pyrotec® "Camp Type" Electrical Connectors, and Paul Cell Cabling passed the arid test with flying colors aboard a Boeing B-52G missile bomber as it was put through a special, rigorous test program.

This B-52G flew half a million miles during the 1000-hour test. Included were a 9,000-mile non-stop flight without refueling and a 15,000-mile non-stop refueled mission. At the conclusion of the test—con-

ducted jointly by AFMDC, SAC, and Boeing flight test personnel—the aircraft was "fine-tooth-combed" in inspection. According to Boeing, it was "found as a thoroughbred."

Products of the Scintilla Division, the Bendix ignition systems, connectors, and cabling proved once more that there is no substitute for experience when it comes to delivering reliable, high-key performance such as required on the mighty B-52G.

**Scintilla Division**  
BENTIX, NEW YORK



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ductor, needed status prompt. Outboard on the east leg of the range, magnetic course 394 deg., the computer called for wind correction at between 6 deg. and 9 deg. Left. Aural signal of the range, monitored as a crosscheck, showed the aircraft on course and compensating correctly for drift.

Flight plan was to turn southeast at Huntington, the intersection of La Guardia's east leg and the southeast leg of the Bridgeport LP Range 052 deg. inbound, proceed to Bridgeport and there execute a circle and on area approach with the CD-4.

On turning the LP enroute to Bridgeport with the computer operative and flying to keep the needle centered would have moved the aircraft immediately off course on a short-cut heading to intercept the Bridgeport range leg. The arc of the plan's right path would have curved inside Huntington.

The problem of pinpointing LP instructions such as Huntington is solved on the CD-4 by holding compass heading, timing the aircraft's LP service in the second station, switching to the ADF ONLY mode and dialing the intersecting radial on the course indicator. When the vertical needle centers, the aircraft is over the intersection and ready to turn inbound.

About 37 mi. from Bridgeport, clearance for the two approach—stage to Runway 34 and on to to Runway 8—was obtained from the tower. Range transmission again went unobstructed easily over the Twin Towers's speaker system, but the primary flight instru-

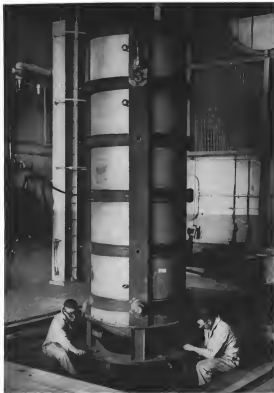


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FMC MAGAZINE, Vol. 11, No. 1  
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count throughout the approach was the CD-4 engine indicator.

At high speed, the rebound course to the range, 252 deg., was called and the needle actively switched to CD ADV, REV, to point into the needle horn while underway on the maneuvering leg. Half way through the 185 deg. time position turn to the east, the needle, polarize switch was returned to NORM.

First portion of the procedure turn was based upon heading and time. In-bound, however, the CD-4's vertical needle was centered, resulting in a heading of 263 deg., an intercept angle of 30 deg. to the northward leg of Bridgport.

The computer, in effect, predicted how fast the standard rate of 45 deg. in entering to course, characteristic reduced on two subsequent procedure turns. Intercept angle as determined by the computer based upon distance from the station and prevailing wind, varying from standard to situation.

After low pass, the Twin Boasans described a specific needle run on route to the field, 35 min. on southward of the station. Although flight path diverged about 450 yds. from the stage leg, the plane crashed in water without report boundaries near its endpoint.

According to ARDC's test pilot and computer engineers, Bridgport's loop range, which held a center tower to prevent permit ADF tracking and avoid tactical voice transmission, is the best available. LF station to be used in conjunction with the CD-4. This maneuver range and station is also one of the best desirable LF navigators to use for conventional ADF homing.

In the VOR approach that followed, the Twin Boasans was flown southward on the 245 deg. radial of Bridgport away. Procedure turn was to north.

When first released on procedure turn, computer called for a heading of 090 deg. to intercept the 065 deg. course to Normin. 6. Approaching this course, as indicated by the main pointer, a vertical needle on the plane's timing column immediately was depressed to disengage the computer without detouring the approach problem. The vertical needle showed that the aircraft's position was still north of the 065 deg. course heading 045 deg. After its interception, the plane flew a direct track to the runway's threshold.

At Macomber Field, two approaches were conducted, the first utilizing all components of the ILS system—the outer and middle line markers, the glide slope and localizer, and the computer heater at the middle marker. CD-4 needle sector was positioned on CD LOC, keeping the timing computer engaged.

Coming out of the procedure turn,

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## BUSINESS FLYING



HUNTING Jet Provost trainer aircraft includes four practice barrels and two rocket projectiles under each wing.

## British All-Jet Class Nears Graduation

By John Tynan

London—First all-graduate pilot course to be phased into Britain's training pattern will be completed in June at No. 2 Flying Training School, Syon, near London.

Graduate pilots will get their "wings" without first having flown a piston engine or tail-draw aircraft. The average time to solo on the latest Hunting Jet Provost Mk. 1 jet aircraft of just

over 11 hr. still compares with the piston-engine pattern.

A typical U.S. Air Force training program, called Project AB Jet (AW No. 14, 1964, p. 115), involves a 36-student class flying Cessna T-37A aircraft planes at Beechfield AFB, Ga.

The various ones has involved most of its full complement of 49 aircraft. The Mk. 1 variant is the latest production aircraft and is the first British aircraft to carry VHF equipment instead of

the current VHF equipment. It is powered by a Bristol-Siddeley Viper engine producing 1,750 hp. thrust and is of single design, having been developed from a full-throttle engine designed for comparable target aircraft.

### No Accidents

Since the course started last October there have been no accidents involving injury or serious aircraft damage. Availability also is reported to have been extremely good and the planned availability target of 65% has been achieved. Minor troubles which were expected with the new aircraft have been overcome. Mostly these were associated with micro-switches in the landing gear system, an start motor, and the radio equipment. None of them has caused the aircraft to be grounded.

The life has been pushed to 400 landings per set, which is four times the figure achieved on the de Havilland Vampire advanced jet trainer which will be ultimately superseded by a later version of the Provost with an uprated Viper producing 2,300 hp. thrust.

### Letter Version

This later version of the aircraft will be used for gunnery, bombing, and rocket firing training and, when it becomes available, will enable a pilot to be trained up to squadron standard on one basic aircraft of a series of \$139 an hour.

The decision to switch to an all-jet training program was taken in October, 1957. It followed two experimental evaluation courses in 1955 using the

original Mk. 1 Provost jet trainer, during which time a new program was developed and aircraft modifications suggested.

These included the need for more thrust, a shorter landing gear fit had the same stress as the piston engine Provost, which required propeller ground clearance) and the standardization of the damped rebound landing gear which had introduced variations in the stalling characteristics between different aircraft, due to the sharp lift coefficient obtainable.

Seating has been placed on a conventional bench and in a more spacious position in the Royal Air Force. It is claimed to have greatly increased flexibility of the 300 man autonomous staff.

New to the Royal Air Force is the employment of instrumented, team working with cockpit tool and component kits. This arrangement facilitates real checks at the end of each day and presents tools and components, particularly maps, bins and washers, from being left in aircraft. Also introduced is a forward supply system which automatically schedules part replacements.

### Provost Trainer

The Provost trainer is a realistic jet aircraft, with the power-to-weight ratio of the Vampire and the performance of the wartime Spitfire fighter.

The all-metal aircraft has an hydraulically-operated nose wheel gear, two-pole two-blade propellers, wheel brakes, Mach meter, oxygen system and ejector seats. Cockpit arrangement provides for side-by-side seating, with full dual control and a combined instrument flying panel. Radio aids include VHF include the Radio Mk. 6 which provides distance measuring and bearing facilities, or a radio compass.

The aircraft has a 1 in 10 rate of roll (170 deg./sec.) and is not much heavier than the North American T-6 to log it. It is particularly light and responsive. Low cut stalling speed is 45 kt. and the aircraft has to be firmly held onto a spin. The stall is straight and steep rather pulling off, leading to believing at the stall.

Maximum speed of the Provost is 290 kt. at 30,000 ft., range is 570 mi. on top with 10 tanks, and endurance is 6 1/2 hours. The Provost gross weight is 7,150 lb. with full 10 tanks and takeoff distance is clear 38 ft. in 2,150 ft.

The flight training program consists of 70 hr. of dual instruction and 41 hr. of solo and progresses through high altitude familiarization and takeoff and landings, to forced landings and low flying. The student continues with instrument flying, navigation, night flying and formation flying.

For the first week of the course the

first attends ground school full-time, and then spends half of each day there for the 25 weeks remaining before final examinations. The other half being spent in the air. Ground instruction, totaling 217 hr. is given in aerobics, anatomy, technical subjects, a weapons, aviation medicine, meteorology, navigation and signals.

Integrated with instruction in three aeromedical subjects in 177 hr. of instruction is active training and fitness subjects which, with flying, make a total of 518 hr. of training during the entire 16-week period. Four months of instruction precedes the flying course.

These four months are best chosen of pilots at Syon, each class having up to 14 students. Total strength of the station is 689. One of the main differ-

ences between the old pattern and the jet training courses is the much greater emphasis on aeromedical, instrument flying and solo aeromedical disciplines. The effects on the high rates between dual and solo flying. Two-thirds of the pilot's 120 hr. flying time up to graduation now is dual, against the 50/50 basis with piston engine training.

Pilots after only about 50 hr. of flying are able to fly alone. This involves a feature which causes flying confidence in bad weather which was not possible with the old course.

An traffic control in a major problem. Missions total up to 1,000 a day, cover of these involving students with little flying experience. With current conditions up to 10 aircraft are allowed to fly at any one time.



French high performance SM-31 Glider has a 56 ft. wingspan, wing surface is 794 sq. ft.

## French SM-31 Glider Undergoes Tests

French SM-31, a new high performance glider built by the Moravia Co. is working up its initial flight tests and will participate in the 1960 World Gliding Championships in Cologne, Germany, this June. The prototype was constructed with French government funds and no production plans have been discussed as yet. The successful flight is derived from the earlier high performance French glider the SM-12. The immediate predecessor was the SM-30 experimental glider first flown in 1957. The SM-31 made its first flight last Jan. 31. Moravia contends that French glider pilot Cordelet later won in the SM-31 an open class competition in Cologne. French officials admit this may be a possibility and that their only choice is between the SM-31 and an improved version of the high performance glider, the August 501.

The SM-31 features a banana form wing with an aspect ratio of 35. Maximum cruising speed is 2.5 mph. Stalling speed is 45 mph at 5 gps and at 55 mph, 7.5 gps. Another feature is maximum glide rate is 10. The SM-31 uses a canard flap plus elevator for maneuvering. Maximum climb rate continuous and flight equipment will permit flight up to 40,000 ft. Gross weight is 1,844 lb.



REFLECTOR sights for instructor and student are mounted on the cockpit starting.

## Whereabouts Unknown

After its towing "calf" slices beneath the sea, a U.S. Navy Polaris submarine may not surface again for many a month. But "out of sight" will not mean "out of mind"—least of all for any potential aggressor. For who could forget that each nuclear-powered submarine could launch 16 Polaris missiles in as many minutes—or that each Polaris missile could destroy a major strategic target 1200 miles away? Lockheed is prime contractor and missile system manager for the Polaris Aerejet-General makes the solid-propellant rocket motor, General Electric the guidance system.

**LOCKHEED**

MISSILE & SPACE DIVISION  
BIRMINGHAM, ALABAMA



BOEING B-17 bomber, converted into a transport for tropical fish, taxis to the ramp at Westchester County Airport, N. Y.

## Converted B-17 Transports Tropical Fish

By Herbert J. Coleman

Vero Beach, Fla.—Tropical fish, a highly perishable commodity, are being successfully air-transported to the U.S. from South America in a wartime Boeing B-17C bomber, converted into a flying aquarium.

Long range capabilities of the airplane solved its transportation timing and space problem for Paramount. Again tuna, fish, of Vero Beach, which for the past 11 years had used weekly cruise planes staging from Consolidated PFY Continues in Lockheed Lodestar.

Using the B-17, which is fitted with auxiliary tanks in forward sections of the wings, Paramount can ship the top tank from South American fish col-

lecting points in 26 flying hours. A second collection run, made about once a month, takes approximately four days for oceanic fish and returns.

F. Cocha, Paramount's president and a 26-year veteran of the tropical fish business, says the B-17 carries 2,000 gal of fuel and consumption has been running about 185 gph. W. P. Meade is chief pilot and leads a crew of mostly four men, one of whom is an expert on care of tropical fish. All are noted pilots.

Paramount operates its own fish collection stations at various locations in Peru, Colombia, Brazil, Guyana, and Surinam and the firm devised a technique of packing the delicate fish for transport.

First Cocha and the fish are care-

fully placed in water-filled plastic bags. Air is then withdrawn from the bags and 100% oxygen is introduced, the bag then is sealed. Next step is to place the bag in a plastic container for reinforcement and the container is stacked in the rear section of the plane and secured. Mortality rate after the 36 hr flight home is quite low, Cocha explained.

The bags are sealed by twisting the tops and sealing the opening with rubber bands. If air when additional oxygen is needed during the flight, it is fed into the bags from one of two high pressure bottles carried in the cargo section.

The tropical fish are segregated in separate bags by various varieties. On occasion, Cocha said, the plane will



TROPICAL FISH, packed in plastic bags and cartons, are unloaded for shipment to dealers. Note fish bags on tail. The truck will deliver the fish to Astoria, N. Y., where Paramount Aquarium operates a distributing facility.



There's plenty of room at the top  
... but there's lots more room  
at the bottom

Look around you. How many men do you see at about your job level and income? Know them pretty well, don't you? Are they smarter than you are? Do they work any harder? Do they possess some "something" that you don't have?

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## Houston Firm Doubles Beech Sales Facilities

Business Aircraft Inc., of Houston Tex., now Beech dealer for Texas and Louisiana, has doubled its sales facilities. New hangar occupies about 40,000 sq ft at Houston International Airport. New facility, completed, and the firm expects to reach a Beech sales volume of about \$2 million this year (AW Feb 22, p. 97). Photo at center is Beech's Queen Air.

hard ten and various baited ponds fish which will attack other fish-as business-creativity. There are sold only to public aquariums.

On most hotels from the South American nations, he added, the B-37 has craned up to 300,000 tropical fish back to Vero Beach.

## B-37 Modifications

Modifications for the fish man were built: comprehensive. Fast, Collier said, now 500,000 lbs. for local boats were installed to keep other fisherman at a constant 300° for the normal. One is used normally and the other backside if B-37 can be operated on the ground during any loading operations.

In addition, the plane was completely reinforced with 4 in. of steel used between the fuselage and a new aluminum outer skin, both used gas windows were fixed over the modifications and a 3 ft x 5 ft cargo door was installed.

New version of the B-37, once used by the angler and boatbuilder, now has become living quarters, with double bunk beds installed in a bulkhead and berthing available for six flight passengers at most. Florida she has been installed in the former radio room aft of the bomb bay and forward of the water gauges system.

The B-37's three turret, which contained three 50 caliber machine guns, has been removed and fixed over, as has the ball turret on the belly and the flight engineer's upper gun position, just aft of the flight deck. The ball turret's position is relatively unchanged, except for gas removal of course.

## Navigation Equipment

Because of its long production history, the Peninsular D-17 carries considerable radio and navigation equipment, but radio has not been installed although it is part of Peninsular's latest plans. Radio equipment includes the automatic direction finder, type ABC-15 series, two ABC-11 transmitters (20

## PROBLEMATIC RECREATIONS 10



Suppose a passenger rocket leaves Earth for Planet X every day at noon. At precisely the same time a rocket leaves Planet X for Earth. Each trip lasts exactly 192 hours (8 days). How many rockets from Planet X will the Nth rocket from Earth meet?

—adapted from an ancient problem

Our authors present data systems for carrier-based ADW system is the smallest, most complete, transmission digital system of its type. Engineers interested in creating circuit designs for digital and analog computers and associated input-output devices for these systems are invited to write Mr. Ron McNamara.

ANSWER TO LAST WEEK'S PROBLEM: IF X equals John's wife's present age and John's former age, and Y equals the interval of time elapsed and difference between the two ages, the solution X=18 can be obtained easily.



LITTON INDUSTRIES  
Electronic Equipment Div.  
Beverly Hills, California

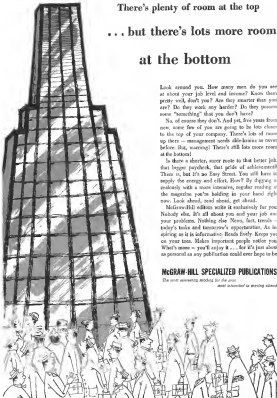
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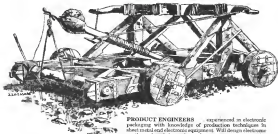
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Please send detailed resume or letters to: Mr. Robert T. Bridges, Employment Manager, Missile Systems Division, Raytheon Company, Antevor Plant, Andover, Mass.



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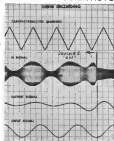
## U. S. Business & Utility Aircraft Shipments

January 1960

Manufacturer & Model		No. of Units	No. Values
Aero Design 440		2	
440E		2	\$1,270,000
Boeing 105		2	
105-1		2	
105-2		2	
105-3		2	
105-4		2	
105-5		2	
Cessna 180		2	
180-1		2	
180-2		2	
180-3		2	
180-4		2	
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Cessna 182		2	
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182-5		2	
Cessna 185		2	
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Cessna 188		2	
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Cessna 190		2	
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Cessna 195		2	
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Cessna 210		2	
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Cessna 260		2	
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Cessna 270		2	
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Cessna 280		2	
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Cessna 290		2	
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290-5		2	
Cessna 300		2	
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300-4		2	
300-5		2	
Cessna 310		2	
310-1		2	
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Cessna 320		2	
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320-5		2	
Cessna 330		2	
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330-4		2	
330-5		2	
Cessna 340		2	
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340-4		2	
340-5		2	
Cessna 350		2	
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350-5		2	
Cessna 360		2	
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360-2		2	
360-3		2	
360-4		2	
360-5		2	
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Structures Laboratory Supervisor will have the responsibility for planning, executing and reporting structural tests of assembly, sub-assemblies and components of solid propellant rockets. Duties will require ability to contact the following:

1. Experimental stress analysis of a structure
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3. Flight and landing load simulation
4. Structural vibration

Education Requirements: B.S. or M.S. in the physical Sciences or Engineering field, with a thesis.

Experience: 2-5 years.

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SYSTEMS CONCEPTSAND DEVELOPING THE TOOLS  
THAT SPEED THEIR DESIGN CYCLE

Defense Systems Department is directing its technical capabilities toward the development of large-scale electronic systems. Extensive work in this work program is the recognition, definition and solution of problems in every aspect of the systems technology.

To accomplish this ambitious task, a growing number of studies are being directed toward the development of unique tools that will aid in the design of superior systems in less time, at lower cost.

A recent contribution by Defense Systems Department in this technology area is GESE (General Electronic Systems Evaluation). Utilizing advanced computer techniques, it enables systems engineers to accurately predict, optimize and synthesize system performance prior to design.

GESE is indicative of the scope of Defense Systems Department's involvement in the systems technology. Many programs offer systems-related experience and scientists an opportunity to participate in new areas of long-term importance.

Senior members of our technical staff would welcome the occasion to discuss personally and in detail the career positions available with GESE. The growing organization. Address your inquiries to: **General Electric**, a Division of the Defense Electronics Division.



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## ENGINEERS

## Opportunities at Kearfott Today Parallel Expansion in Diverse Areas

Long occupying a unique position in the fields of electronic and electro-mechanical components and precision instrumentation, Kearfott — in recent years — has moved closer and more into the development of complete systems for Aero-Space, Guidance, Navigation and Control.

This has led to major staff expansion, requiring a whole new organizational structure, in which a multiplicity of E&D Design and Production operations are now grouped in four main Divisions: the SYSTEMS, CYBERDYNAMICS, ELECTRO-MECHANICAL and PRECISION COMPONENT DIVISIONS.

Many new positions — at all levels — have been created, and a number still remain to be filled. All offer challenging opportunities for rapid professional development and personal advancement in stable, profitable companies.

Why not study the areas of opportunity now open — then let us hear what Kearfott can offer YOU?

## VICE PRESIDENT &amp; GENERAL MANAGER

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Intelligent Guidance Digital Computers  
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and related design  
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facilities. Involves  
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equipment of exact  
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## PRECISION COMPONENT DIVISION

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Precision Assembly  
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precision design  
and assembly test  
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Also Openings in Field Engineering, Sales Engineering and Proposal Liaison (at described level)

Write in confidence to Mr. Paul Kall, Dept. E-9

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## IN TOUCH WITH NEW HORIZONS

Another achievement of IBM Applied Scientists:  
computer program for distillation tower design

Making hard machines out of ideas is a task of the IBM Applied Scientist. Through unique and creative applications of data processing, he is changing the worlds of science, industry and business.

One team of Applied Scientists worked closely with IBM customers to develop a new, far more efficient method of designing distillation towers. They created a program for computer analysis of towers with any number of feed and side streams.

Other teams are investigating computer techniques for mathematical physics, machine tool programming, taxonomy, industrial forecasting methods, and information retrieval. The variety of projects is unlimited.

You too may make a vital contribution to this challenging profession. There are openings in many cities for men and women with advanced degrees in engineering, mathematics, or a physical science, or with a degree in one of these areas plus a Master's degree in business administration or experience in computer programming.

For a confidential interview at your convenience, contact any IBM Branch Office or one of these Regional Managers of Applied Science:

L. M. Fulton IBM Corporation 425 Park Avenue New York 22, N. Y.	R. W. De Bo IBM Corporation 615 S. Michigan Ave. Chicago 5, Ill.	L. C. Hubbard IBM Corporation 3424 Wilshire Blvd. Los Angeles 5, Cal.
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DATA PROCESSING DIVISION

**IBM**



## LETTERS

### Vital Issues

From time to time our politicians and governmental officials become sufficiently specific to go on record regarding their positions relative to various problems in our military space efforts. With electronic technology I just need to wonder whether it would be feasible for you to summarize and publish the position of these people on vital issues. It would be of great merit since to me it is confusing as to which agency is not as "X" or "Y" conscious as my business. Where, please drop us the good news.

A. N. BARNES

Philo Verden Estates, Calif.

(Aviation Week plan to do so—E2)

### Defense Costs

By the late 25 issue, "President John F. Kennedy for Defense" says a 25 year cost that "Daisy Cooney B-58s has been brought in 1961 at a cost of \$1,600 billion."

Really? I read that, and see its dollars are being squandered at the rate of plus \$100 million per three short ranged turbojets, per streamer that never should have been delivered. The weekly stage \$100 currently depends on the B-12 but on striking one 172 wage that it could have not less than a dozen at the least model. \$125 into \$100 in wage plus affecting expenditure for \$100 million.

My daughter is now will be going into the defense technology. When she does have a "Nuclear" technology location of Defense—she looks like something that would make a drunk sailor look like a Southern belle here. W. McCord

Tipnaps, Calif.

(Because of limited production, cost is \$1,000. However, if a device is made to order \$1,500 in D's as quantities, cost will drop considerably—E2)

### Customer Service

I have read your March 25 letter to B-12 and believe W. E. Gallagher, in his letter to SPANCO, has done it. He also has been taken and Retirement of Air Line Passenger of America, a speaking order is just as the he just can't be placed.

I have been fixed on the advice of America on business about radically since 1945 and have legend over 500,000 in as a passenger. This amount of being has been rec'd and not all of the wage program terminals, and a great many of the smaller ones across the country. It has put me in all of the major trunk air lines and most of the smaller feeder lines and has satisfied them in all weather two dollars and expanded me in all types of air line personnel and passenger service.

In view of this experience, I feel that I can spend with some authors, and could like to command traffic on "These days of personal interest in the country" that Gallagher mentions in his letter.

"Making the schedule" will go just well with Gallagher, whenever they don't but a great percentage of the time they do. Joe

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low, neither nature doesn't give a damn about either drives and doesn't schedule the number to suit its manager. It's a rock of the common sense that the number is able to be, I was don't either.

Technical facilities—not so hot and the air getting better. There you see the St. Louis, Cleveland, Washington National or Miami International info! I have never seen too much brains offering an air of the air in the secure borders as the oldest stops or "pumpkin cooker" airports served by the faster air in commercial. You can't expect it to be the leader of the world, the traffic just won't bear it.

"Airline driving"—well, what about it? It's not it or better, and I think most people do.

"Airline safety"—correct, but the B-12 is, but a reasonable picture and it will keep you alive the hour so that you are in the air.

"Airline safety and flight safety"—I am with Gallagher which could work auge optical order equipment and flight safety.

"Indefinite personal service" is the able and product of the world. I am of course including safety which should go without saying. I have found the military or discontinue airline engine in my company, very much a party. Of course the flight line crew check might not have the time to do more and direct the before of pilot flight with one not read at the time the airline personnel involved it is to correct the problem, do a check job. This is serving a lot considering the demands of some of the world. If you find "indifference" in fact on the surface to the conductor on some are called.

"Unrestrained order"—don't you know where are concerned? The airlines are professionals at their jobs and they can't make any sense with a 154 million airline on the way to the ground. They will do as they please, unless FAA and airline authorities, to prevent delay. There are drive limits, for mechanical failure, weather or mechanical equipment, vehicle, because of weather at the other end of the route, but these delays are due to unavoidable cause and cannot possibly be classified as unrestrained.

If Mr. Gallagher wants "service" he will get it from the airlines. If anything is done, he will get it from the airlines. Service is a given here. They have highly paid vice presidents in charge of ordering but service. You think a man for service and they are not.

At Chicago O'Hare Field for example, United has a power engineer, will moving ramp in the passenger can walk directly from the terminal to the airplane without

being bothered by the "terribly outside air" or being forced to walk up one single step.

The airlines have listed some of the most advanced designs in the world at this point in time. The success of the airplane beautiful and beautiful just for the passenger. In fact they are beautiful you are not sure if you are going to get your own time or the company.

On some of the super-duper jet engine flights, the only thing left to attend service is the only thing to be added as found in the B-12. "Nuclear drive and service" placed in a suit equipped with a self-purified daily running piston heater for service, proper air circulation and atmosphere.

I personally like good service as well as the best man, and I certainly feel that I am getting my money's worth 75% of the time, when I fly with the commercial airlines. If Gallagher is really serious about the state of current interest that he mentioned in his letter, I think a well directed letter of constructive criticism to the proper authorities of subject airline or airlines, would do it. I am not a pilot, but I am a SPANCO/NOVA appreciation in quality of could cost something.

Conclude Yours,

C. D. PETER  
1104 Berry Road  
Alam, N. Ohio

### Aerojet JATO

In Herbert J. Coleman's article on the Aerojet JATO in the March 1 issue [p. 36], the final paragraph reads as follows: "For their field performance, the Super G-15 can be fitted with Aerojet J-250 or standard JATO units, at an extra cost of \$1,500. The weight penalty is 180 lb."

The graph appearing at the bottom of the captioned Aerojet J-250 unit is a gas installation in the article. However, we should like to correct the impression that these rocket engines are intended to gas installation in the article. Rocket engines should be used to correct the impression that these rocket engines are intended to gas installation in the article. Rocket engines should be used to correct the impression that these rocket engines are intended to gas installation in the article.

Also, there is no weight penalty for the installation of these Aerojet rocket engines in the Super G-15. Because of the gas pressure which is available to the pilot, the engine has been certified with an increase in gross weight of 100 lb. to cover the installed weight of the rocket engine. We would appreciate it if you could make the additional of these points so that they might serve to correct false impressions which might otherwise be passed from the pamphlet.

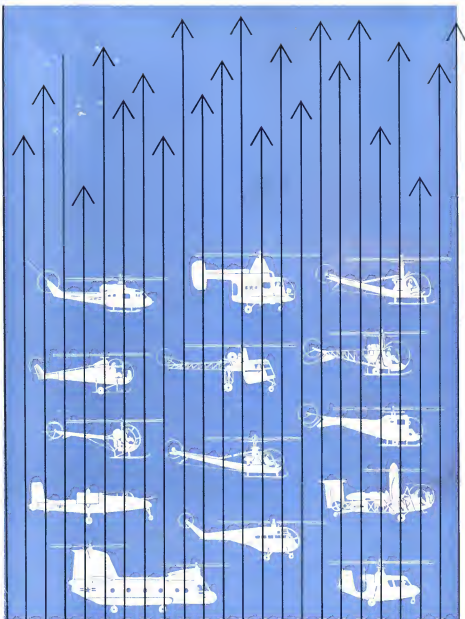
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